Town of Fairhaven

Municipal Vulnerability Preparedness Planning

Community Resilience Building Workshop Summary of Findings Report

April 2020

Prepared by

PUNCHARD CONSULTING

In partnership with

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Town of Fairhaven
Community Resilience Building Workshop
Summary of Findings

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1. Overview

This Summary of Findings report presents the results from a participatory, community-based effort by the Town of Fairhaven to reduce risk and build resilience to climate change. Building upon previous hazard mitigation and resiliency planning efforts, and undertaken as part of the Massachusetts Municipal Vulnerability Preparedness (MVP) program, the Town engaged dozens of local and regional stakeholders in a process to understand current and future vulnerabilities, strengths, challenges, and opportunities as it relates to creating a more climate-adaptive and hazard-resilient community. This report summarizes those efforts, including the prioritization of specific actions and next steps as identified by key stakeholders in Fairhaven's MVP planning process.

The primary purpose of this report is to compile and communicate the findings of Fairhaven's Community Resilience Building (CRB) Workshop as described in Section 2. The content of this report is open to comments, corrections, and updates from workshop participants and other members of the community. The Town's progress towards a more climate-adaptive and hazard-resilient community is ongoing, and the process will only be strengthened by the future engagement of many voices and the consideration of various perspectives and visions.

About Fairhaven

The Town of Fairhaven (pop. 16,904) is a seaside community on the shore of Buzzards Bay, directly across the harbor from the City of New Bedford. With nearly 30 miles of shoreline, a long history tied to the region's fishing industry, and a working waterfront within the New Bedford-Fairhaven Designated Port Area (DPA), Fairhaven's identity is closely tied to the water. Coastal landforms include a series of beaches, bays, coves, tidal flats, and large expanses of salt marsh. Additional open space, recreation, and natural resource areas are abundant in Fairhaven including conservation land, biking and walking paths, swimming and boating amenities, wildlife viewing areas, and numerous historical sites.

Fairhaven's picturesque 19th century town center is clustered around the harbor area, with more suburban development and commercial corridors extending north and east from the center. The more inland and northeast areas consist of open fields and farms on slightly rolling terrain separated by numerous freshwater marshes and wooded swamps. Sconticut Neck, a 4.5-mile long peninsula stretching into Buzzards Bay, extends to the south with mostly low-density residential development interspersed with expanses of fields and salt marshes. Connected to the Neck by a causeway is West Island, a 535-acre island with a mostly residential development in addition to the Town Beach and the densely forested West Island State Reservation.

Fairhaven's Need to Address Climate Change

Fairhaven has always been vulnerable to a range of natural hazards that come with being a coastal community. Since 1953, the town has been included in more than 25 major disaster or emergency declarations that have included hurricanes, tropical storms, nor'easters, blizzards, floods, and other severe weather events. The town has also experienced extreme temperatures, droughts, and brushfires, and most of its shoreline areas continue to experience chronic coastal erosion. Each of these hazards are considered significant risks for Fairhaven based on damages and loss from previous events, as well as the probability of future occurrences and their anticipated destructive impacts.

As noted in the Town's 2018 Hazard Mitigation Plan, one of the most important factors in assessing natural hazard risk is the consideration of climate change and its potential effects on future events. Today's science and best available data confirms that many of Fairhaven's existing hazard risks and vulnerabilities will increase in the future, and the Town understands and accepts this reality. Of the nine natural hazards assessed in the plan, eight were identified as becoming more frequent and/or severe due to the anticipated effects of climate change. These include coastal erosion and sea level rise, coastal storms, drought, extreme temperatures, wildfire, flood, severe weather, and severe winter storms.

Floodwaters inundated the causeway to West Island during Hurricane Bob in 1991. Image credit: M.L Baron, West Island Weather Station.

Although the hazard analysis and risk assessment for the Town's Hazard Mitigation Plan was completed in 2017, the Commonwealth's subsequently released data on downscaled projections for changes in temperature, precipitation, and sea level rise for Massachusetts validated its basic findings and conclusions. Rising temperatures, changing precipitation patterns, increasing sea levels, and extreme weather will increasingly and adversely affect the community throughout the 21st century. Fairhaven's need to address climate change is based on these scientific facts.

In recognition of these changing hazards, and to further advance its commitment to becoming a more sustainable and resilient community, the Town of Fairhaven has joined other Massachusetts cities and towns participating in the Commonwealth's MVP program. In 2019 the Town applied for and received an MVP Planning Grant from the Massachusetts Executive Office of Energy and Environmental Affairs (EEA) to more specifically address climate change impacts on Fairhaven's infrastructure, residents, and environment. The execution of this MVP grant, including the process described below and the Community Resilience Building Workshop, will result in Fairhaven's certification as an MVP Community and provide access to additional state funding in support of actionable climate adaptation measures.

Fairhaven's MVP Planning Process

Beginning in September 2019 and continuing through June 2020, Fairhaven partnered with Punchard Consulting to design and facilitate a planning process that would result in the Town becoming an MVP Community. The process included multiple phases and several key steps designed to augment previous planning efforts and advance the implementation of specific hazard mitigation and climate adaptation actions. In summary, Fairhaven's MVP planning process included the following three project tasks:

Task 1. Community Resilience Building (CRB) Workshop

Task 1 includes the completion of a stakeholder-driven workshop using the *Community Resilience Building Workshop Guide* provided by EEA and facilitated by state-certified MVP Providers. This task also included a public listening session on workshop findings to begin broader community outreach efforts. The CRB Workshop is further described in Section 2 with key results and outcomes summarized throughout the remainder of this report.

Task 2. Town Policy and Regulatory Review

Task 2 includes a detailed inventory and evaluation of existing Town bylaws that warrant a review through the lens of climate change and its anticipated impacts for Fairhaven. There are numerous Town policies, local laws, and regulations in place that could potentially be modified to help build community resiliency, and this assessment will help advance recommendations that were included in the Town's Hazard Mitigation Plan and recently updated Master Plan. This task will be further described along with key results and outcomes as a separate annex to this report.

Task 3. Targeted Vulnerability & Adaptation Assessments for High Risk Assets

Task 3 includes the completion site-specific evaluations of the vulnerability and potential adaptation actions for Fairhaven's Top 5 "high risk" assets as identified and prioritized through the CRB Workshop and MVP planning process. The Town has already determined several community assets to be at risk to climate-related natural hazards, and these more detailed assessments will secure more information on the key vulnerabilities and potential solutions for those considered at greatest risk. This task will be further described along with key results and outcomes as a separate annex to this report.

To guide and support completion of the above tasks, the Town of Fairhaven:

- Created an MVP Steering Committee composed of key internal stakeholders to serve as a core team with oversight of the MVP planning process (see Section 8 for a complete listing of committee invitees/members)
- Established goals and objectives for the MVP planning process
- Developed and executed a *Stakeholder Engagement Strategy* to support the planning process by generating public awareness and creating stakeholder interest and investment in the project
- Coordinated, scheduled, and hosted multiple planning meetings and the CRB Workshop
- Provided the Punchard Consulting team access to relevant documents, data, facilities, and other resources useful to the planning process
- Pre-identified the priority hazards for the CRB Workshop based on previous planning efforts, updated climate projections, and input from the MVP Steering Committee
- Vetted and ratified the highest priority community actions and list of high risk assets resulting from the CRB Workshop
- Arranged for a public listening session to share and discuss the results from the CRB workshop and solicit feedback from the community

The remainder of this report provides greater detail about the MVP planning process and key findings from the CRB Workshop in particular. Supplementary documentation and information on other tasks are provided in separate appendices or annexes to this report.

2. Community Resilience Building Workshop

The Town of Fairhaven hosted its Community Resilience Building (CRB) Workshop on January 16, 2020. The workshop was held as a 7-hour event at Town Hall Auditorium and included 28 active participants. It was conducted in accordance with the *CRB Workshop Guide* and facilitated by the Punchard Consulting team, including five state-certified MVP Providers.

The overall goal of the CRB Workshop was to bring together community members to identify and prioritize actions to reduce risk and improve resilience across Fairhaven. The workshop's central objectives included the following:

- Define top local natural and climate-related hazards of concern
- Identify existing and future strengths and vulnerabilities
- Develop prioritized actions for the community
- Identify immediate opportunities to collaboratively advance actions to increase resilience

The CRB Workshop was organized under the direction of the Town's MVP Steering Committee. Preparations began during their first meeting on October 15, 2019 at which time members discussed the needs for and desired outcomes from the workshop. It was agreed at this meeting that a primary purpose for the workshop would be to foster collaboration with and among community stakeholders to advance the education, planning, and ultimately implementation of the top priority actions to build resilience in Fairhaven. Desired outcomes included successfully leveraging past and concurrent planning efforts, public outreach and/or stakeholder engagement opportunities, as well as incorporating new information, best available data, and tools available through *resilient MA*.[1]

Fairhaven's MVP Steering Committee began preparations for the CRB Workshop in October 2019.

It was also determined by the MVP Steering Committee that a successful CRB Workshop must include a broad range of stakeholders, and an initial list of more than 60 potential invitees was generated at their first meeting. The committee was careful to ensure that workshop invitees represented the diversity of the community, including a range of backgrounds and interests that cut across multiple sectors and features to be discussed at the workshop (social, infrastructural, and environmental). Choosing, inviting, and effectively engaging these targeted stakeholders included a three-pronged approach as developed through the Town's MVP stakeholder engagement strategy. Ultimately 28 of the 52 people invited to the workshop attended. Participants comprised a good cross-section of community stakeholders, including Town staff from many departments combined with representatives from multiple Town boards and commissions, neighborhood groups, businesses, non-profit organizations, and state agencies (see Section 8 for a complete list of participants, as well as those invitees who were unable to attend).

[1] The Massachusetts Climate Change Clearinghouse (resilient MA) is a gateway to data and information relevant to climate change adaptation and mitigation across the state. It provides the most up-to-date climate change science and decision support tools for the Commonwealth to support scientifically sound and cost-effective decision making for policy-makers, practitioners, and the public.

The specific structure of Fairhaven's CRB workshop evolved between October and December 2019, with multiple iterations of the draft agenda and run of show. As shown below, the final agenda included a series of presentations, small group exercises, and large group discussions that focused on consensus building as recommended in the *CRB Workshop Guide*.

CRB Workshop Agenda

AGENDA

Town of Fairhaven

Community Resilience Building Workshop

January 16, 2020

8:30 **Registration, Coffee & Refreshments**

9:00 **Welcome & Workshop Overview**
- Whitney McClees, Conservation Agent & Sustainability Coordinator
- Darrin Punchard, Punchard Consulting

9:15 **Participant Introductions**

9:40 **Kickoff Presentation/Discussion:** *Climate Change, Natural Hazards, and Resilience in Fairhaven*
- Punchard Consulting Team

10:30 ***BREAK***

10:40 **Community Vulnerabilities & Strengths**
- Intro Presentation
- Small Group Exercise 1

12:00 **LUNCH / Guest Speakers**
- Mark Rees, Town Administrator
- Courtney Rocha, Massachusetts Executive Office of Energy & Environmental Affairs

1:00 **Community Actions**
- Intro Presentation
- Small Group Exercise 2

2:15 ***BREAK***

2:25 **Priority Actions**
- Small Group Report-Outs
- Large Group Discussion
- Determine Overall Priority Actions
- Determine Top 5 High Risk Assets

3:45 **Summary & Closing**

4:00 **Adjourn**

For small group exercises, workshop participants were split into four working groups. Participant groupings were pre-assigned by Punchard Consulting in consultation with the Town using the "mixed sectors" option as described in the *CRB Workshop Guide* (putting diverse sectors together to foster an exchange of different perspectives and actions for community resilience building).

The workshop was supported by five experienced MVP facilitators and a range of helpful materials including CRB risk matrices, large base maps, flip charts, and a series of handout packets for each small working group that included additional maps, climate projections, useful terminology, and more. The

combination of these materials provided visualization and decision-support tools that enabled workshop participants to effectively complete their small group exercises as guided by their MVP facilitator. As documented through this Summary of Findings report, the process resulted in a workshop that was highlighted by informative input, shared experiences, and meaningful dialogue.

CRB Workshop Presentations

Whitney McClees, MVP Local Project Lead, Conservation Agent and Sustainability Coordinator, Town of Fairhaven


Mark Rees, Town Administrator, Town of Fairhaven


Darrin Punchard, MVP Facilitator, Punchard Consulting Team

Courtney Rocha, MVP Southeast Regional Coordinator, MA Executive Office of Energy and Environmental Affairs

Jamie Caplan, MVP Facilitator, Punchard Consulting Team

Aaron Weieneth, MVP Facilitator, Punchard Consulting Team

CRB Workshop Small Group Exercises

3. Top Hazards and Vulnerable Areas

Top Hazards

The Town of Fairhaven determined that the top priority hazards for the CRB Workshop would be pre-defined by the MVP Steering Committee. This decision was made because (1) the Town had already identified and classified its greatest hazard risks through the community-based hazard mitigation planning process completed in 2018, and (2) pre-defining the top hazards would allow more time for workshop participants to identify and discuss specific community vulnerabilities and strengths as well as evaluating and prioritizing actions.

During their first meeting on October 15, 2019 Fairhaven's MVP Steering Committee determined that the following four (4) main hazards should be the focus for discussions at the CRB Workshop:

- **Sea Level Rise** – including long-term changes to shoreline, flood and erosion hazard areas, base flood elevations, etc.
- **Flooding** – including coastal flooding (recurring tidal events, storm surge, wave action, etc.) and inland flooding (heavy rainfall + stormwater/drainage events).
- **Severe Storms** – including hurricanes, nor'easters, winter storms, and other extreme weather events.
- **Heat and Drought** – including increasing temperatures, heat waves, consecutive dry days, etc.

The determination of these top hazards was informed by the conclusions of previous hazard planning efforts as well as updated information and relevant data on climate change and future conditions (including downscaled climate projections for the Buzzards Bay Basin). All of this information and data was shared at the outset of the CRB Workshop through an interactive kickoff presentation, and through subsequent discussion the top 4 hazards listed above were affirmed by participants through unanimous consent. It was agreed by all that these four main hazards have historically impacted Fairhaven and/or are projected to have notable impacts for the community in the future.

Areas of Concern

Once the top hazards were agreed upon at the CRB workshop, participants were introduced to the first exercise and worked in their assigned small groups to identify what they saw as Fairhaven's key vulnerabilities and strengths. Vulnerabilities and strengths were discussed across three core areas including infrastructural, societal, and environmental features. Infrastructural features include those assets of the built environment that may be vulnerable to hazards as well as to serve and strengthen the community (e.g., roads, bridges, utilities, etc.). Societal features may include people, places, and services (e.g., vulnerable population groups, neighborhoods, businesses, etc.). Environmental features include those natural resources or systems that provide community benefits including but not limited to hazard risk reduction (e.g., wetlands, floodplains, conservation lands, etc.).

In general, the following categories and specific locations, assets, or other resources represent the common areas of concern identified and discussed across multiple small groups during the first exercise.

Infrastructural Vulnerabilities
• Water and wastewater systems – including sewer pump stations in coastal flood hazard areas; water pipes along West Island Causeway; wastewater treatment plants; outdated/aging stormwater drainage facilities in older parts of town • Hurricane barrier and protective dike system (Egypt Lane area) • Roadways, bridges and culverts – including several coastal and/or low-lying areas that are subject to flooding (multiple areas along Route 6 and Sconticut Neck Road, West Island Causeway, etc.); numerous evacuation routes potentially impacted • Senior housing – including Fairhaven Housing Authority complexes and other long-term care facilities • New public safety complex *(proposed)* • Schools / emergency shelters • Electric utilities
Societal Vulnerabilities
• Vulnerable populations – including seniors; people with disabilities; residents with medical or other special needs; younger/school-aged populations; year-round residents on West Island; low-moderate income residents in North Fairhaven • Medical facilities – including urgent care (in town) and access to hospitals/health centers in neighboring towns • Flood-prone residential areas/neighborhoods – including coastal properties along Sconticut Neck; West Island; Poverty Point; Wilbur's Point • The working waterfront – including Fairhaven Shipyard and other marine-based industries in the New Bedford-Fairhaven Designated Port Area (DPA) • Large employers – including but not limited to Acushnet Company, Brahmin, Nye Lubricants, Southcoast Hospital Group, Fairhaven Shipyard Company, and Southcoast Hospital Group • Historic/cultural landmarks – including Town Hall, Millicent Library, Fairhaven High School, Unitarian Memorial Church, Fort Phoenix Reservation • Transient populations – including seasonal residents, commuters, and tourists/visitors
Environmental Vulnerabilities
• Coastal landforms – including beaches, dunes, salt marshes, tidal flats, etc. • Drinking water supplies – including freshwater resources and 4 groundwater wells in Fairhaven • Agricultural lands – including important agricultural landscapes and working farms • Trees – including street trees/canopy and woodland areas • Open space – including protected/conservation lands as well as unprotected municipal lands • Parks and recreation – including state and town-owned parks; beaches; Phoenix Bike Trail • Insects and vector-borne diseases (increasing concern) • Hazardous materials/contaminants – particularly at industrial sites along the waterfront

4. Current Concerns and Challenges Presented by Hazards and Climate Change

As described in Section 1, Fairhaven has always been vulnerable to a range of natural hazards that come with being a coastal community. With nearly 30 miles of shoreline, and much property and economic value along this shoreline, the greatest natural hazard risks for Fairhaven include **sea level rise, increased coastal flooding, and more frequent and intense storm surge**. While long-term increases in sea level are of concern, a more urgent threat to the community is the influence sea level rise will have on the severity of episodic hazard events such as storm surge, wave action, and coastal flooding, in addition to the exacerbation of ongoing coastal erosion. The Town expects sea level rise to be an amplifier of the frequency and magnitude of these other coastal hazards to which much of the town is already exposed and highly vulnerable. It is also worth noting at 4 feet of sea level rise it is assumed that the existing hurricane barrier and dike system would be overtopped during a 100-year storm event, resulting in a significant expansion of current flood hazard areas and a 180% increase in the number of properties potentially affected.[2] Supporting risk map figures provided in Appendix C show the areas of the community at greatest risk to sea level rise and this projected floodplain expansion, in addition to hurricane storm surge inundation.

Another significant risk for Fairhaven is the threat of more **interior flooding due to heavy rainfall events.** The principal sources of riverine flooding in Fairhaven are the Acushnet River and its tributaries which help drain the Taunton and Buzzards Bay watersheds. Of perhaps greater concern is the likely increase in the frequency of urban/stormwater flood events caused by heavy precipitation that can overwhelm local drainage systems and cause major impacts to low-lying areas across town. These events often strike rapidly and have occurred in areas generally not considered at risk to major flooding, including areas outside of the Town's mapped floodplains. This is particularly true for more urbanized areas along Route 6 and isolated areas with outdated or undersized stormwater infrastructure near the historic Town Center. The compounding effects from high tides and coastal storm events can make these interior flooding situations worse by impeding drainage flows at stormwater outfalls. These incidents, which are anticipated to become more frequent due to sea level rise and more heavy downpours, can create significant threats to public safety due to the lack of warning and flooded roadways, and as experienced in recent years, significant damage and loss to property owners can result from flooded basements and other impacts.

Flooding on Huttleston Avenue (between Francis and Green Streets) following a heavy rainfall event in November 2019. Image credit: Karen Vilandry.

Increasing temperatures are also a concern. Fairhaven may be less susceptible to extreme heat events than inland areas due to the cooling effect of sea breezes from Buzzards Bay. However, with heat waves projected to become much more commonplace in the future, there are potentially significant health

[2] *Projected Expansion of the Floodplain with Sea Level Rise in Fairhaven, Massachusetts*. Buzzards Bay National Estuary Program and Massachusetts Office of Coastal Zone Management. November 13, 2012.

implications to Fairhaven's more vulnerable populations such as seniors, lower income residents, and those already dealing with respiratory or other health problems. Increasing average temperatures and the potential for drier growing seasons are also a concern to Fairhaven in terms of potential impacts to community's agricultural lands and businesses located mostly in the northeast part of town.

As described in Section 1, Fairhaven's need to more deliberately address these climate-related hazards is grounded in the most up-to-date climate change science and best available data. Per the latest climate projections for Massachusetts[3] and the State Hazard Mitigation and Climate Adaptation Plan[4], changing precipitation patterns, rising temperatures, higher sea levels, and extreme weather will increasingly and adversely affect the Commonwealth throughout the 21st century.

More specifically, as discussed at the CRB Workshop and summarized in the below table, the types of climate change impacts Fairhaven expects to see in the future include more days with heavy precipitation, increased average temperatures (both annually and seasonally), and more days with extreme heat (over 90 degrees Fahrenheit). At the same time climate change is anticipated to bring more consecutive dry days, increasing the frequency and duration of short-term droughts. Fairhaven is also projected to see increasing sea level rise with a likely range between 1.5 and 4.1 feet by the end of the century, as well as an increased frequency and magnitude of severe storm events.

Anticipated Climate Change Impacts for Fairhaven

	**Changes in precipitation**	• More days with heavy precipitation • More consecutive dry days, increasing the frequency of droughts
	**Rising temperatures**	• Increased average temperatures (both annually and seasonally) • More days with extreme heat (over 90 degrees Fahrenheit)
	**Sea level rise**	• Likely range between 1.5 and 4.1 feet by 2100
	**Extreme weather**	• Increased frequency and magnitude of severe storm events

Specific Categories of Concerns and Challenges

As in most communities, Fairhaven is not uniformly vulnerable to the risks and projected impacts of climate change. Specific locations, assets, populations, and resources will be affected to a greater extent than others. During the first small group exercise, workshop participants identified the following items as their community's key vulnerabilities (categorized according to infrastructural, societal, and environmental vulnerabilities).

[3] Massachusetts Climate Change Projections - Statewide and for Major Drainage Basins. Northeast Climate Adaptation Science Center at UMass-Amherst. Published by Massachusetts Executive Office of Energy and Environmental Affairs. March 2018.
[4] Massachusetts State Hazard and Climate Adaptation Plan.

Infrastructural Vulnerabilities

Water and Wastewater Systems Performance

Workshop participants expressed concern about the resilience and reliability of water/wastewater systems due to the critical functions they serve coupled with the vulnerability of specific infrastructure assets to hazard impacts. Particular concerns and challenges were noted with regard to sewer pump stations located in coastal flood hazard areas, many of which are expected to see increasing flood risk in the future due to sea level rise and potentially more severe coastal storms. The Town's sewer lines and wastewater treatment facilities, including the main facility on Arsene Street and a smaller plant on West Island, were also identified as potential challenges as it relates to dealing with future flood conditions. The Town's continued access to a safe drinking water supply was raised as another key vulnerability to address through coordination with the Mattapoisett River Valley Water Supply District (MRVWD) which provides all potable water for the Town. Four of the District's eight ground water wells which pump water to the MRVWD treatment facility are located in Fairhaven but not considered at risk to future saltwater intrusion from sea level rise.

Roadway Flooding

Multiple roadways in Fairhaven were identified as vulnerable to current flood hazards, including several locations along the Route 6 corridor (Huttleston Avenue), Sconticut Neck, and West Island. In some cases, such as along Route 6, repetitive flooding has been attributed to sedimentation and debris in combination with outdated or undersized stormwater drainage facilities. Other roadways are vulnerable to tidal flooding during coastal storm events. The causeway to West Island is a particular concern as it is the only roadway connecting the mainland to West Island and is already at high risk to flooding, wave action, erosion, and storm surge. During the workshop, participants expressed concern over the Town's ability to maintain the causeway under future climate conditions due to sea level rise and recurring tidal flooding. It was also noted that some of the roadways considered most vulnerable to flooding in Fairhaven also serve as designated emergency evacuation routes. Any temporary flood inundation or damage to these roadways not only impact general mobility in the community but can also limit the access and egress of residents and emergency responders during and following hazard events.

New Bedford Hurricane Protection Barrier and Fairhaven Dike

For more than 50 years, the hurricane barrier stretching across the mouth of New Bedford Harbor and extending through Fairhaven has provide protection from major coastal storms. The barrier was completed in 1966 and is operated by the US Army Corps of Engineers in coordination with the City of New Bedford and the Town of Fairhaven. The barrier consists of three separate structures: the main barrier across the harbor, Clarks Cove Dike in New Bedford, and Fairhaven Dike. Fairhaven Dike is an earthen dike with stone slope protection landward of the tidal marshes at Priests Cove (at the end of Egypt Lane). It starts at high ground near the foot of Lawton Street and runs easterly around 3,100 feet, with a maximum elevation of 20 feet. The existing barrier system provides protection to much of the community including Fairhaven's historic town center. Although it was accredited by FEMA in 2011 to provide protection from the 100-year (1-percent-annual-chance) flood event, it is expected that the barrier would fail in a 500-year (0.2-percent-annual-chance) storm. Also, as noted earlier in this section, it is assumed that with 4 feet of sea level rise the barrier would be overtopped during a 100-year storm event. Lastly, over the past several years the closure of the hurricane barrier has been used to mitigate storm surge and tidal flooding during king tide events. Workshop participants agreed that this is not a sustainable practice over the long-term as the frequency of these events are anticipated to increase.

Public Facilities

Workshop participants identified a variety of public facilities throughout town that provide critical functions or services to the community, for which any disruption could have widespread or cascading impacts. Primary concerns included Town-owned buildings such as Town Hall, the Public Works facility, schools, shelters, and the Millicent Library. Participants also expressed concern for the public safety complex which jointly houses the Town's Police and Fire headquarters, with a lot of discussion focused on the future relocation and reconstruction of that facility from its current location on Washington Street. Other facilities of concern included the four Fairhaven Housing Authority properties in addition nursing homes and other long-term care facilities. While none of these facilities are located in identified high hazard areas, participants agreed that their resilience to future climate conditions must remain a priority for the community. It was also noted that a recent facilities improvement study conducted by the Town identified significant needs for most public buildings due to deferred maintenance and non-compliance with current building code standards.

Societal Vulnerabilities

Vulnerable Populations

In considering the impacts of climate change, workshop participants expressed concern for community residents that may be more susceptible due to their exposure or sensitivity to certain hazards. This includes people with pre-existing health conditions, disabilities, lower income levels or other socioeconomic factors that may limit their capacity to adapt to or recover from climate impacts. Senior residents were of particular concern as Fairhaven has a large and increasing older population, with more than 22% of town residents over 65 years in age. This is significantly higher than the statewide average of 16% and the trend of an aging population, which is most likely to continue over the next few decades, poses a significant challenge to the community which strives to support aging-in-place for its seniors. Like most communities, Fairhaven also has numerous residents with disabilities or special medical needs that can limit their mobility and access to certain municipal services, especially during and after emergency or disaster events.

Economic Drivers

Although home to some large companies, there are no dominant industries in Fairhaven and most businesses have fewer than 20 employees. This includes clusters of small businesses along the Route 6 commercial corridor and near Town Center. Workshop participants did express several concerns though with regard to some key economic drivers that could be vulnerable to future climate change impacts. Fairhaven has an important working waterfront along the Acushnet River. The area is linked to the New Bedford region's fishing and maritime industry and supports it by providing ship repair and outfitting services. This is where the Steamship Authority services their fleet (the largest ferry service to the Islands of Martha's Vineyard and Nantucket from Cape Cod) and much of the waterfront is within the New Bedford-Fairhaven Designated Port Area (DPA), a state-designated area of concentrated industrial activities. The largest business in the DPA is the Fairhaven Shipyard Company which employs more than 100 people. Other economic drivers cited by workshop participants as potential concerns included marinas and other water-dependent businesses, as well as other commercial establishments which are heavily dependent on summer tourism, recreation, and seasonal residents or visitors.

Historic Buildings

Workshop participants routinely noted Fairhaven's historic and iconic structures as not only unique but critical to preserve and maintain in the face of a changing climate. Fairhaven's community landscape includes a historic central area with magnificent nineteenth century public buildings. Between 1885 and 1906, prominent Fairhaven resident and philanthropist Henry Huttleston Rogers gifted funds that led to the design and construction of the Town Hall, Fairhaven High School, the Millicent Library, and the Unitarian Memorial Church among other buildings (in addition to streets and the public water system). Today these buildings make up some of the State's finest collection of National Registered Historic public buildings, almost all designed by Boston architect Charles Brigham. While they are not located in identified high hazard areas, participants expressed concern over their long-term resiliency to climate-related hazards and their ability to resist or withstand the forces of wind, water, fire, and other perils.

Development Pressures

It was widely recognized by workshop participants that while much of Fairhaven's landscape has been preserved in its natural state, future growth and development pressures pose a continued threat to those areas left unprotected by land use regulations or other restrictions. It was also recognized that many of these natural features including trees and forests, wetlands, salt marshes, grasslands and other open lands provide beneficial functions that include reducing climate change impacts. Participants expressed strong support for the protection of sensitive areas through proper enforcement of the Town's zoning bylaws, wetlands regulations, and other development standards. They also suggested that some of these local policies and regulations may need to be revisited to identify opportunities to further enhance the community's resilience to projected future climate conditions, particularly as it relates to new construction or substantially improvements to properties located in the town's expanding coastal flood hazard areas.

Environmental Vulnerabilities

Coastal Ecosystems

Fairhaven's abundance of coastal ecosystems is one of the features that workshop participants felt were among the community's greatest strengths as well as its greatest vulnerabilities when it comes to climate change. As noted above these resources can serve as a beneficial buffer to reduce the impacts of coastal hazards, but they are also greatly exposed and sensitive to long-term changes in climate conditions – especially sea level rise. Fairhaven's natural ecosystems include barrier beaches, salt marshes, tidal flats, and other estuarine resources which serve a number of important functions including the provision of wildlife habitat, recreation, shell fishing, nutrient storage, contaminant filtering, storm impact abatement, and erosion control. The assessment, preservation and enhancement of these natural protective features in the face of rising seas was uniformly identified by workshop participants as a critical action for the community to undertake in order to improve its resilience to climate change. Most participants agreed that these types of nature-based solutions are preferable to building seawalls or other protective structures that provide only localized protection and often come with higher costs and negative consequences.

Inland Open Spaces and Protected Lands

Workshop participants also identified the community's inland natural resources as a key environmental strength and vulnerability to climate change. The majority of Fairhaven is characterized by gently rolling

plains, hardwood forests, and croplands/pasture along with freshwater wetlands, rivers, and streams that drain to the estuarine and coastal areas along Buzzards Bay. Fortunately, many of these resources are protected through the Town's wetland and conservation regulations coupled with additional partnership-based efforts to preserve its natural open space and recreational lands. These efforts will continue through implementation of the Town's Master Plan and Open Space & Recreation Plan, but workshop participants expressed concern that many of the community's vacant and agricultural lands are not currently protected from future development which could have negative impacts on the community's overall sustainability and resilience to the impacts of climate change. The benefits of preserving Fairhaven's forests and urban tree canopy, wetlands, and floodplain areas in their natural state were widely discussed but participants also recognized that improving and expanding these efforts will be even more critical in the years ahead.

Water Quality

Workshop participants expressed several concerns with regard to the quality and vulnerability of Fairhaven's water resources. In fact, "water" was the most common word cited across the CRB risk matrices during the first exercise on community strengths and vulnerabilities. Notable water resources in Fairhaven include Buzzards Bay, New Bedford Harbor and the Acushnet River. More localized water bodies in these areas include Shaw's Cove, Stony Cove, Little Bay, Nasketucket Bay, and Priests Cove. Freshwater resources consist of the Nasketucket River, which rises in northeast Fairhaven and flows south through several small ponds and tributaries to an estuary in Little Bay. Its watershed is important as a reserve source of groundwater for drinking, though the MRVWD water treatment facility in Mattapoisett supplies all potable water for the town. MRVWD's source water quality is monitored on a regular basis in order to ensure compliance with state and federal standards for quality and safety. Concerns shared by workshop participants had more to do with water contamination issues associated with the industrial working waterfront, as well as infiltration and inflow of untreated sewage discharges and/or surface water runoff during heavy precipitation events.

Ecological Stresses

Some additional concerns expressed by workshop participants as it relates to future climate change impacts included the increasing threat of invasive species to local flora and fauna. Fairhaven's vulnerable coastal habitats are already being increasingly degraded by non-native plants which can disrupt the natural ecosystem balance. Non-native invasive species are also capable of disrupting the ecology of Fairhaven's inland forests and woodlands, and the varied tree specimens at Riverside cemetery were identified as a particular concern. Also, in recent years Fairhaven has seen an increase pests and vector-borne diseases which threaten human health (e.g., mosquitoes carrying West Nile Virus or Eastern Equine Encephalitis, and ticks spreading Lyme disease or Rocky Mountain Spotted Fever). Participants agreed that these ecological stresses and impacts will become more prevalent if the community's natural ecosystems are simultaneously weakened due to changes in climatic conditions.

5. Current Strengths and Assets

Just as certain locations, assets, populations, and resources in Fairhaven stand out as particularly vulnerable to the effects of climate change, other community features are notable for their ability to enhance resilience and bolster the Town's climate adaptation initiatives. During the CRB Workshop, participants identified the following items as their community's core strengths and expressed interest in leveraging them in support of future resilience building efforts. Notably, some of the features identified as community strengths or assets were also considered as potential vulnerabilities.

Commitment to Resilience – As demonstrated through the Town's recently adopted Hazard Mitigation Plan, Master Plan Update, and Open Space & Recreation Plan, Fairhaven understands and is preparing for the predicted impacts of climate change. A common theme of climate resilience and risk reduction is woven through the goals and recommended actions of each plan.

Active Citizenry – Fairhaven is fortunate to have many dedicated, well-informed people in the community who voluntarily serve and support the Town through its local boards and commissions, many of which help contribute to making Fairhaven a more sustainable and resilient community.

Protective Infrastructure – Fairhaven is fortunate to have some critical infrastructure assets that strengthen its resilience to climate-related hazards. Examples include the New Bedford Hurricane Barrier and Fairhaven Dike, numerous seawalls, an extensive network of roads, bridges and bike/pedestrian paths, and nearly $10 million of stormwater drainage improvements in low-lying neighborhoods near the historic Town Center.

Natural Resources – Fairhaven's abundance of natural protective systems and resources is a key strength to be further protected, enhanced, and leveraged to improve community resilience. As detailed in previous sections these resources include but are not limited to coastal salt marshes, wetlands, floodplains, woodlands, and a healthy tree canopy that provide multiple natural and beneficial functions for the community at large.

Reliable Utilities – The Town of Fairhaven continues to invest capital funds and work with other community partners to enhance the reliability, redundancy and resiliency of local utilities. This includes assessing and prioritizing improvements for its water and wastewater systems and closely coordinating with Eversource on the community's electrical supply, particularly as it relates to storm response and recovery operations.

Emergency Preparedness – Fairhaven has a dedicated team of Town staff and civilian volunteers focused on preparing for and responding to emergency or disaster events, as well as educating residents on the steps they can take to help Fairhaven become a better prepared and more resilient community.

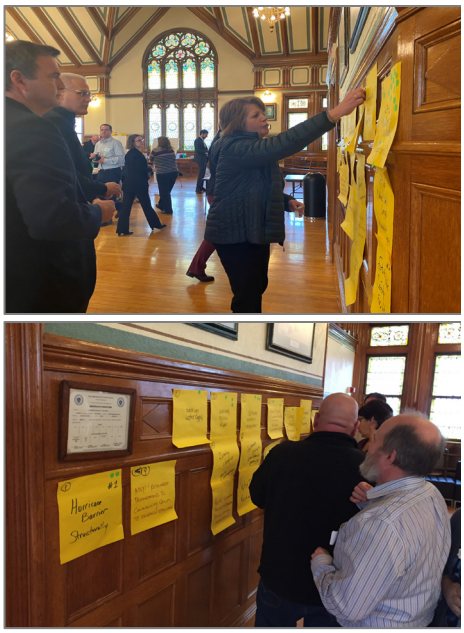
Community Networks and Resources – Fairhaven has strong social networks in place that foster community cohesion and become a key asset during and following emergency or disaster events. This includes numerous civic organizations, neighborhood improvement associations, and social service agencies that focus on caring for some of the community's most vulnerable residents, including elder populations and those with disabilities or other special medical needs.

6. Top Recommendations to Improve Resilience

After determining Fairhaven's key vulnerabilities and strengths, workshop participants listened to an invited presentation from Ms. Courtney Rocha, EEA's Southeast Regional Coordinator for the MVP program. Ms. Rocha focused her presentation on the types of climate adaptation projects EEA is currently promoting and funding through MVP Action Grants. The information and examples shared by Ms. Rocha served to help ignite ideas and discussions on the community actions most needed to improve resilience in Fairhaven.

During the second small group exercise, workshop participants worked to collectively identify actions that would address the vulnerabilities and build upon the strengths determined in the first exercise. Led by their MVP facilitators, each group generated recommended solutions that cut across six categories of community actions, including: local plans and regulations; structure and infrastructure projects; nature-based solutions; education and awareness; and emergency preparedness. MVP facilitators then worked with each small group to evaluate and prioritize recommended actions based on a range of factors. The general criteria used during this process included the action's urgency, funding availability, long-term benefits versus costs, level of public acceptance and stakeholder support, impacts from recent hazard events, and the ability to meet other community goals.

Following the second exercise, a spokesperson from each small group presented a summary of their top 3-5 highest priority actions to all workshop participants. These small group report-outs provided the opportunity for all workshop participants to ask questions or provide additional thoughts on recommended actions. They also helped workshop participants identify similar or overlapping actions that could be combined into one recommendation. Following a final large group discussion on the highest priority actions, each individual participant was then given an opportunity to vote on the specific actions they feel should be among the top recommendations to improve resilience in Fairhaven.



Workshop participants vote on the top recommendations to improve resilience in Fairhaven.

Top Recommendations

Results of the final voting exercise indicated the following actions should be considered as the top overall recommendations for Fairhaven.

Vulnerability and Adaptation Assessments for Sewer Pump Stations

The existing and future vulnerability of Fairhaven's sewer pump stations was a major concern for workshop participants, particularly for those stations that are older (pre-2000) and/or located in identified coastal flood hazard areas. This concern was also identified in the Town's hazard mitigation plan which recommended site-specific vulnerability assessments for 10 specific pump stations considered at high-risk in the 2014 Technical Report, *"Climate Change Vulnerability Assessment and*

Adaptation Planning Study for Water Quality Infrastructure in New Bedford, Fairhaven and Acushnet." Workshop participants expressed strong support for confirming these risk determinations and evaluating potential climate adaptation solutions that include but are not limited to backup power/redundancy plans, elevation, floodproofing, and other retrofits to ensure proper functionality and long-term resiliency for those pump stations identified as most critical and vulnerable. These assessments will result in the identification and prioritization of the pump station retrofit projects for the Town to implement. *Note: Task 3 of the Town's MVP Planning Grant included a targeted vulnerability and adaptation assessment for high risk assets, including sewer pump stations, and will be provided as a separate annex to this report.*

Resilience Improvements for Critical Roadways

Some of the roadways considered most vulnerable to current and future flooding in Fairhaven are also identified as critical major roadways that serve as designated emergency evacuation routes. Primary concerns include Route 6, North Sconticut Neck Road, and the West Island Causeway. Any temporary flood inundation or damage to these roadways not only impact general mobility in the community but can also limit the access and egress of residents and emergency responders during and following hazard events. The West Island Causeway and Goulart Memorial Bridge, which traverses Nasketucket Bay Inlet and connects Sconticut Neck to West Island, is considered among the Town's most vulnerable infrastructure assets at risk to coastal erosion, sea level rise, storm surge, and recurrent flooding. Workshop participants expressed strong support for the Town to further assess the risk and improve the resilience of this and other critical roadways through future investments in necessary flood mitigation and other climate adaptation measures (including but not limited to roadway elevation). Such investments should include preemptive capital improvements as well as consideration for those repair or reconstruction projects to be undertaken following destructive hazard events.

Salt Marsh Accretion Assessment

One of the most concerning environmental vulnerabilities identified by workshop participants was the potential loss of coastal salt marsh habitat caused by an inability of marsh accretion to keep pace with sea level rise. Fairhaven's salt marshes are particularly vulnerable to rising sea levels because they are generally within a few feet of existing sea elevations. For some locations this vulnerability is further compounded by limited opportunities for landward marsh migration due to existing physical barriers (for example, roads, seawalls, parking lots, upland slopes, etc.). Workshop participants expressed strong support for the Town to complete a targeted assessment of salt marsh accretion to (1) identify the extent to which salt marshes are accreting, where they are migrating to, and what their boundaries may be in the future; and (2) use that information to help further protect, preserve, and restore those areas as needed. As part of this action, workshop participants determined that a primary location to initially focus this assessment is at West Island Town Beach, an area surrounded by salt marshes but also identified as a priority area for restoration and conservation efforts. Applying nature-based solutions to alternatives for the repair and replacement or relocation of the existing Town Beach parking lot was also identified as a related action item, and an immediate pilot project for the Town to consider pursuing – possibly in coordination with the Buzzards Bay Coalition and other partner organizations.

Review and Update Town Bylaws for Resilience

A common theme resulting from workshop exercises centered around the need to review and improve local regulations in ways that can help increase community resilience. Participants expressed general

concerns that the Town of Fairhaven's existing policy and regulatory framework did not adequately account for projected future conditions and impacts from climate change. Specific areas of concern include the Town's zoning bylaws and other development/growth management regulations, stormwater management policies, wetlands regulations and other conservation-related bylaws (erosion, water quality, floodplain management, etc.). Potential recommended improvements included policies to prioritize nature-based solutions over engineered structures, increasing the resiliency and sustainability of buildings, and requiring tree plantings and/or the use of green infrastructure for development and redevelopment projects. They suggested the Town consider additional regulatory tools such as Transfer of Development Rights (TDRs), revised setbacks, revised floodplain guidelines, floodproofing, and incentive-based programs such as Mass Save® and FEMA's Community Rating System). Workshop participants expressed strong support for the Town Policy and Regulatory Review to be completed under Task 2 of the Town's MVP Planning Grant. *Task 2 includes a detailed inventory and evaluation of existing Town bylaws that warrant a review through the lens of climate change and its anticipated impacts for Fairhaven, and it will be provided as a separate annex to this report.*

Route 6 Culvert Upgrade

Workshop participants determined that the existing culvert at the 260 block of Route 6 / Huttleston Avenue may be in need of an upgrade or replacement to alleviate current and future flooding issues at this location. The culvert is designed to convey water under Route 6 via a tributary to the Naskatucket River which flows between the Naskatucket Cemetery and G. Bourne Knowles & Company property, portions of which are in high risk flood hazard areas. This concern had been identified in the Town's hazard mitigation plan as a high priority action and described as follows: "Identify and evaluate potential upgrades and alternatives to the existing culvert and flood control structures between 265 and 267 Huttleston Avenue to alleviate future flood hazard threats. Objective is to eliminate or reduce flooding across Route 6 (State-owned road) and further upstream at Bridge Street (Town-owned road)." Workshop participants were heavily in favor of this priority action item, which gained even more support when discussed in combination with concerns over future hazard conditions and the potential siting of the Town's new Public Safety Complex in the same vicinity (further described below). *Note: Task 3 of the Town's MVP Planning Grant included a targeted vulnerability and adaptation assessment for high risk assets, including the Route 6 culvert, and will be provided as a separate annex to this report.*

Vulnerability and Viability Assessment for New Public Safety Complex

Among the currently proposed locations for the Town's future Public Safety Complex is the existing G. Bourne Knowles & Company property at 267 Huttleston Avenue (Route 6). Although site selection and acquisition remain an ongoing process for the Town, workshop participants expressed concern over this potential location due to current and future flood hazard conditions. Portions of this property and adjacent areas, including Route 6, are located in FEMA-mapped special flood hazard areas. As such it is recommended that the Town conduct a detailed assessment of the vulnerability and viability of this location for the new complex. Such an assessment should thoroughly analyze the site's suitability based on existing flood hazards, future climate projections or other environmental constraints, with the purpose of helping to ensure the long-term operability, sustainability, and resiliency for new Public Safety Complex and all of its critical functions through appropriate design standards. *Note: The Town has directed the completion of an environmental site assessment (conducted by Pare Corporation) that determined the site in question was suitable depending on the design and placement of the building.*

Other Prioritized Recommendations

Through the CRB small group exercises, workshop participants identified a total of more than 50 possible community actions to improve resilience. Of those actions recommended for further consideration, 22 were determined to be of higher priority (including those integrated into the Top Recommendations described above), while 13 were considered of moderate priority and 14 of lower priority. These additional recommended actions are listed below according to their assigned priority level. Please refer to Appendix A for pictures of all completed risk matrices and map products that were used by workshop participants to develop and prioritize these recommendations.

Other High Priority Actions

- Coordinate with the City of New Bedford and the US Army Corps of Engineers to assess the existing conditions of the New Bedford Hurricane Barrier and Fairhaven Dike and certify its climate readiness (to account for sea level rise projections).
- Back-up the main water supply by retrofitting water pits on Popes Island and Howland Road.
- Conduct presentations to community and neighborhood groups on the MVP process to increase their engagement with the Town's resilience efforts and assist with public education.
- Continue supporting and investing in affordable housing for disabled and senior residents.
- Conduct resilience assessment of harbor waterfront and identify measures to minimize the reliance on operation of the hurricane barrier's gates.
- To help address contamination issues associated with the working waterfront, inform property owners about the Massachusetts Office of Technical Assistance and Technology services to help increase outreach and education.
- Enforce sump pump/stormwater disconnection program. Integrate into standard building permit inspection process.
- Conduct an economic assessment of the impact of invasive species (flora and fauna). Update conservation bylaws to require native plantings.
- Clarify and sustain public waterfront access to West Island Reservation and Shaw Farms through improved mapping, signage, and environmental awareness. Engage with educational outreach partners including service organizations, disability advocacy organizations, etc.
- Increase the resilience and sustainability of buildings. Conduct a vulnerability analysis to develop a long-term resilience plan for public facilities and private housing stock.
- Continue joint regional efforts to purchase conservation land; promote public education on its relevance to Fairhaven's water quality and drinking water supply.
- Evaluate alternative sources of water (groundwater wells, rain barrels) on West Island.
- Enhance coordination of Town's emergency response team and community groups in advance of hazard events to determine needs during emergency events, particularly for elderly and lower income residents. This includes improving the resilience of the Council on Aging facility.

Moderate Priority Actions

- Create a historic district (combined for town buildings and historic buildings).
- Short-term rental requirements; education on emergency/evacuation information for summer residents and tourists.
- Street tree policy – include mandatory replanting when trees are dead and or removed.

- Assess resilience options for provision of water and wastewater service to West Island.
- Develop Community Resilience Hubs (meeting area, training center, emergency supplies, etc.); see New Bedford example. Make emergency shelters more inviting; assess designation of a pet-friendly shelter.
- Develop an open space acquisition planning and prioritization process. Seek funding for open space acquisition and other properties that could provide resilience functions (flood storage, etc.)
- Require additional tree plantings and the use of green infrastructure for new development and redevelopment projects. Conduct a pilot on a proposed development.
- Conduct outreach program to inform property owners how they can help prevent the spread of invasive species (flora and fauna).
- Keep historic buildings maintained. Assess utilities placement (e.g. potential for elevating electrical/mechanical equipment) and other low-hanging climate-ready fruits.
- Clarify and sustain public access to Fairhaven's open spaces and protected lands (including waterfront areas, Buzzards Bay Coalition lands, Egypt Lane / Boys and Girls Creek, Little Bay Preserve, Marsh Island, and areas within the Naskatucket River basin) through improved mapping, signage, and environmental awareness. Engage with educational outreach partners including service organizations, disability advocacy organizations, etc.
- Continue supporting and investing in human service agencies and local improvement organizations (Rotary Club, Lions Club, Neighborhood Improvement Associations, etc.).
- Community farms / orchards; compost facility.

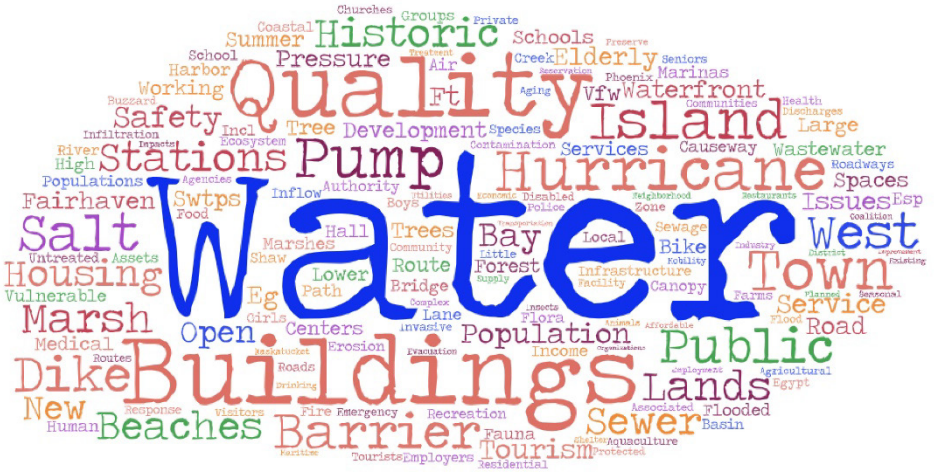
Lower Priority Actions

- Salt marsh protection around dike.
- Elderly/vulnerable population shelter – make it comfortable and supplement facility with emergency trainings.
- Increase educational opportunities for local businesses and community groups to increase their own resilience (i.e., developing emergency plans, completing mitigation/adaptation actions, etc.).
- Acknowledge the Phoenix Bike Trail as advantageous because of high ground location (former rail bed); incorporate into resilience planning.
- Conduct an updated vulnerability assessment for the wastewater treatment plant based on climate projections.
- Vegetated bioswales for water detention (historic district).
- Vulnerability assessment of public housing stock; develop resilience guidelines (e.g. floodplain guidelines & setbacks); assess whether additional shelters should be added (e.g. on Islands).
- Investigate evacuation routes & access, establish safe houses, maintain access to urgent care.
- Vulnerability study / investigate housing stock and increase resilience (elevate, modify); education on risk; CRS.
- Conduct vulnerability assessment for the maritime industry (economic impacts); possibly move storage facilities inland.
- Natural restoration of dunes and marshes
- Purchase more conservation & farmland (CP money), education
- Bat houses, education (school outreach & community engagement)
- Add trees and conservation land

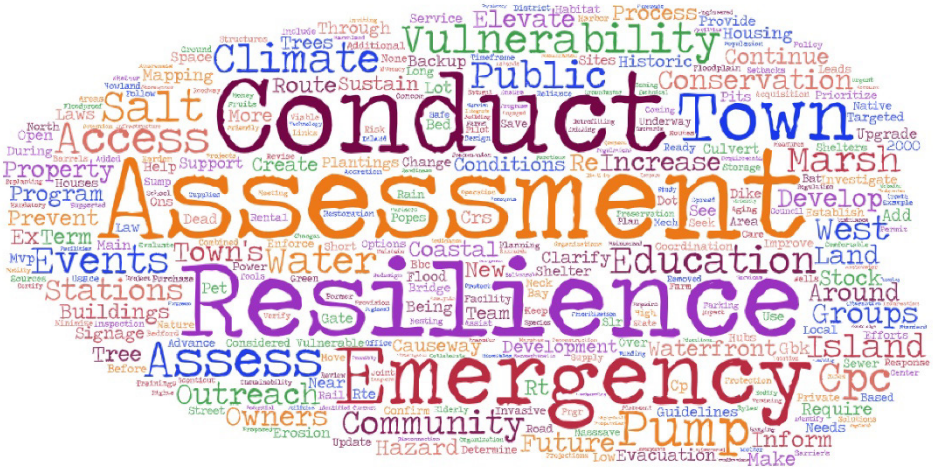
7. Conclusion and Next Steps

This report provides a detailed summary of Fairhaven's community-driven CRB Workshop as part of its MVP planning process. Most importantly it serves to document the climate-related concerns and challenges for the community as expressed by stakeholder participants, in addition to a lengthy list of recommendations to improve Fairhaven's long-term climate resilience. Key findings were generated through the use of participatory small group exercises through which workshop attendees identified Fairhaven's current vulnerabilities and strengths, in addition to a variety of community actions that are needed to reduce these vulnerabilities and reinforce the strengths. The results of these small group exercises were recorded in CRB risk matrices (provided in Appendix A) and used to facilitate large group discussions to identify the top overall recommendations for Fairhaven to pursue (listed in Section 6).

One notable observation from the first small group exercise is that many of Fairhaven's ***vulnerabilities and strengths*** are flood-related and directly linked to its unique coastal environment. As seen in the below summary word cloud, "water" was the term most often cited across all CRB risk matrices.



Another general conclusion is that Fairhaven should continue conducting assessments and investing in activities to strengthen community resilience, emergency preparedness, and education. The below word cloud summarizes the most commonly used terms during the second exercise on ***community actions***.



Next Steps

Fairhaven is committed to maximizing its strengths, minimizing vulnerabilities, and becoming a more sustainable and resilient community in the face of a changing climate. The CRB workshop was an opportunity for key community stakeholders to help the Town identify and prioritize the actions needed to advance this commitment, and the MVP process has served as an important catalyst for moving forward. As it does, the Town of Fairhaven will continue its community outreach and engagement efforts while striving to become a model MVP community for the Commonwealth.

In terms of immediate next steps, the Town will continue its community outreach efforts by publicizing and making this report available to community residents and other members of the public. In May 2020 the report will be posted to a dedicated MVP page on the Town's website, along with a pre-recorded presentation of the report for members of the community to view at their convenience. The Town will also post an online survey to solicit questions and capture additional community input on the summary of findings. These online materials will be developed and provided in lieu of the Town hosting an in-person listening session in order to comply with the State's emergency orders and guidance for social distancing during the COVID-19 pandemic. As with a traditional public listening session, these alternative outreach and engagement measures will provide an opportunity for any member of the community to learn, submit questions, and provide feedback on the findings and recommended actions included in the report. The availability of the above materials will be well advertised and promoted by members of the MVP Steering Committee and other Town staff per the Town's MVP stakeholder engagement strategy.

The Town will also continue its MVP planning tasks while moving forward to address the top recommended actions identified at the CRB Workshop. This includes the following steps:

- Completing an inventory and evaluation of existing Town bylaws and other local regulations or policies that warrant a review through the lens of climate change.
- Conducting site-specific evaluations of the vulnerability and potential adaptation actions for Fairhaven's top 5 high risk assets (as informed by workshop participants and determined by the MVP Steering Committee).
- Completing a joint MVP Action Grant with the City of New Bedford to evaluate the vulnerability of the harbor and waterfront areas (including the DPA) to sea level rise and storm surge inundation based on updated coastal flood modeling. This project will the development of new guidelines to promote more resilient design and construction for development or redevelopment projects based on future climate and coastal flooding conditions.
- Continuing to pursue additional external grant funding to help implement the priority actions identified in this report and through the MVP planning process. This includes but is not limited to MVP Action Grants that Fairhaven will be eligible to apply for on its own following its certification as an MVP Community.
- Coordinating the integration of priority recommendations into other local planning and decision-making processes. This includes incorporating recommended actions into the implementation and future updates of the Town's Hazard Mitigation Plan, Master Plan, Open Space & Recreation Plan, Capital Improvements Plan, Hurricane/Emergency Plan, Harbor Plan, and other mechanisms as appropriate and as opportunities arise.

8. Supporting Information

This report has been prepared in accordance with the Community Resilience Building (CRB) Workshop Guide and MVP "Summary of Findings Template Guidance" provided by the Massachusetts Executive Office of Energy and Environmental Affairs (EEA). Funding to support the Town of Fairhaven's MVP planning process was provided by EEA through an MVP Planning Grant issued to the Town during the fiscal year of July 2019 through June 2020 (ENV 19 MVP 01). The Town of Fairhaven contracted with Punchard Consulting LLC to support the Town in executing its MVP Planning Grant.

Report Citation

Punchard Consulting LLC (2020). Community Resilience Building Workshop Summary of Findings. Town of Fairhaven, Massachusetts.

MVP Project Team

Local Project Lead:

- Whitney McClees, Conservation Agent and Sustainability Coordinator, Town of Fairhaven

Punchard Consulting Team (MVP Provider):

- Darrin Punchard, AICP, CFM (Punchard Consulting, Lead Facilitator, Certified MVP Provider)
- Jamie Caplan (Jamie Caplan Consulting, Facilitator, Certified MVP Provider)
- Dave Hampton (re:ground llc, Facilitator, Certified MVP Provider)
- Isabel Kaubisch (Nitsch Engineering, Facilitator, Certified MVP Provider)
- Aaron Weieneth, AICP (AECOM, Facilitator, Certified MVP Provider)

MVP Steering Committee

The primary role of the MVP Steering Committee was to oversee and support a successful, collaborative approach for the MVP planning process. The following table lists all members invited to participate on Fairhaven's MVP Steering Committee.

Name	Title	Affiliation
Todd Correia	Deputy Chief	Fairhaven Fire Department
Tim Cox	Harbormaster / Shellfish Warden	Fairhaven Marine Resources Department
Paul Foley	Director of Planning and Economic Development	Fairhaven Planning and Economic Development Department
Frank Fostin	President	Fairhaven Improvement Association
Mary Freire-Kellogg	Health Agent	Fairhaven Board of Health
Vinnie Furtado	Public Works Superintendent	Fairhaven Public Works Department
Michael Karalis	Former President	West Island Improvement Association
Jeannine Lopes	Chairperson	Board of Health

Whitney McClees	Conservation Agent and Sustainability Coordinator	Fairhaven Conservation and Sustainability Department
Sue Morris	President	East Fairhaven Improvement Association
Pauline Parker	President	North Fairhaven Improvement Association
Cora-Dorothy Peirce	President	Fairhaven Acushnet Land Preservation Trust
Mark Rasmussen	President	Buzzards Bay Coalition
Ann Richard	Chair	Fairhaven Sustainability Committee
Krisanne Sheedy	Executive Director	Fairhaven Housing Authority
Jay Simmons	Chairperson	Fairhaven Conservation Commission
Kristian White	Building Commissioner	Fairhaven Building Department

CRB Workshop Participants

The following table lists the community stakeholders who actively participated in the CRB Workshop, in addition to those who were invited but unable to attend and participate.

Name	Title	Affiliation
Workshop Participants		
Louise Barteau	Environmental Advocate	Fairhaven Acushnet Land Preservation Trust
Jared Blandino	Community Relations	Eversource
Andrea Coates	District Environmental Engineer	MassDOT
Todd Correia	Deputy Chief	Fairhaven Fire Department
Tim Cox	Harbormaster/Shellfish Warden	Fairhaven Marine Resources Department
Kaisa Cripps	Member	Fairhaven Agriculture Commission
Denise Cromwell	Director of Operations	Murphy and Others Living Interdependently for Future Endeavors, Inc. (M.O.L.I.F.E.)
Paul Foley	Director of Planning and Economic Development	Fairhaven Planning and Economic Development Department
Mary Freire-Kellogg	Health Agent	Fairhaven Board of Health
Vinnie Furtado	Public Works Superintendent	Fairhaven Public Works Department
Jeffrey Furtado	Water Superintendent	Fairhaven Public Works Department
Dave Janik	South Coastal Regional Coordinator	Massachusetts Office of Coastal Zone Management
Jack Lopes	Community Relations	Eversource
Whitney McClees	Conservation Agent and Sustainability Coordinator	Fairhaven Conservation and Sustainability Department
Cathy Melanson	President	Fairhaven Business Association
Pauline Parker	President	North Fairhaven Improvement Association

Michele Paul	Director	City of New Bedford, Environmental Stewardship
Ann Richard	Chair	Fairhaven Sustainability Committee
Courtney Rocha	MVP Southeast Regional Coordinator	MA Executive Office of Energy and Environmental Affairs
Edward Rose	Member, Board of Directors	North Fairhaven Improvement Association
Krisanne Sheedy	Executive Director	Fairhaven Housing Authority
Jay Simmons	Chairperson	Fairhaven Conservation Commission
Kristian White	Building Commissioner	Fairhaven Building Department
Additional Workshop Invitees		
Howe Allen	Owner & Broker	Howe Allen Realtors
Brendan Annett	Vice President	Buzzards Bay Coalition
Dr. Robert Baldwin	Superintendent	Fairhaven School Department
M.L. Baron	Resident / Weather Spotter	West Island Weather
Gerry Bernard	Construction Engineer	MassDOT
John Charbonneau	Highway Superintendent	Fairhaven Public Works Department
Robert Conklin	Manager of Gas Operations	Eversource
Joe Costa	Executive Director	Buzzards Bay National Estuary Program
Beth David	Editor	Fairhaven Neighborhood News
Joy Duperault	Director, Flood Hazard Management Program	Massachusetts Department of Conservation & Recreation
Bob Espindola	Selectman	Fairhaven Board of Selectmen
Lisa Esten	President	West Island Improvement Association
Timothy Evans	President	Fairhaven Historical Society
John Farrell	Chairman	Fairhaven Open Space & Recreation Plan Committee, Planning Board
Frank Fostin	President	Fairhaven Improvement Association
Derek Frates	Director	Fairhaven TV
Dan Freitas	Selectman	Fairhaven Board of Selectmen
Michael Karalis	Former President	West Island Improvement Association
G. Bourne Knowles	Tree Warden	Fairhaven Tree Warden
Carolyn Longworth	Director / Member	Millicent Library / Fairhaven Acushnet Land Preservation Trust
Jeannine Lopes	Chairperson	Board of Health
Jeffrey Lucas	Chairman	Community Preservation Committee
Kevin McLaughlin	Chairman	Fairhaven Economic Development Committee / Fairhaven Shipyard Companies Inc.

Sue Morris	President	East Fairhaven Improvement Association
Charles Murphy	Chairman	Board of Selectmen
Bill Napolitano	Environmental Program Director	Southeastern Regional Planning and Economic Development District
Wayne Oliveira	Chairman	Fairhaven Historical Commission
Cora-Dorothy Peirce	President	Fairhaven Acushnet Land Preservation Trust
Mark Rasmussen	President	Buzzards Bay Coalition
Linda Schick	Sewer/Wastewater Superintendent	Fairhaven Public Works Department
Tom Sheehan	Restoration Supervisor	Eversource
Anne Silvia	Director	Fairhaven Council on Aging
Mark Sylvia	Town Moderator	Fairhaven Town Moderator
Brian Wotton	Chairman	Fairhaven Board of Public Works

Town of Fairhaven CRB Workshop Participants

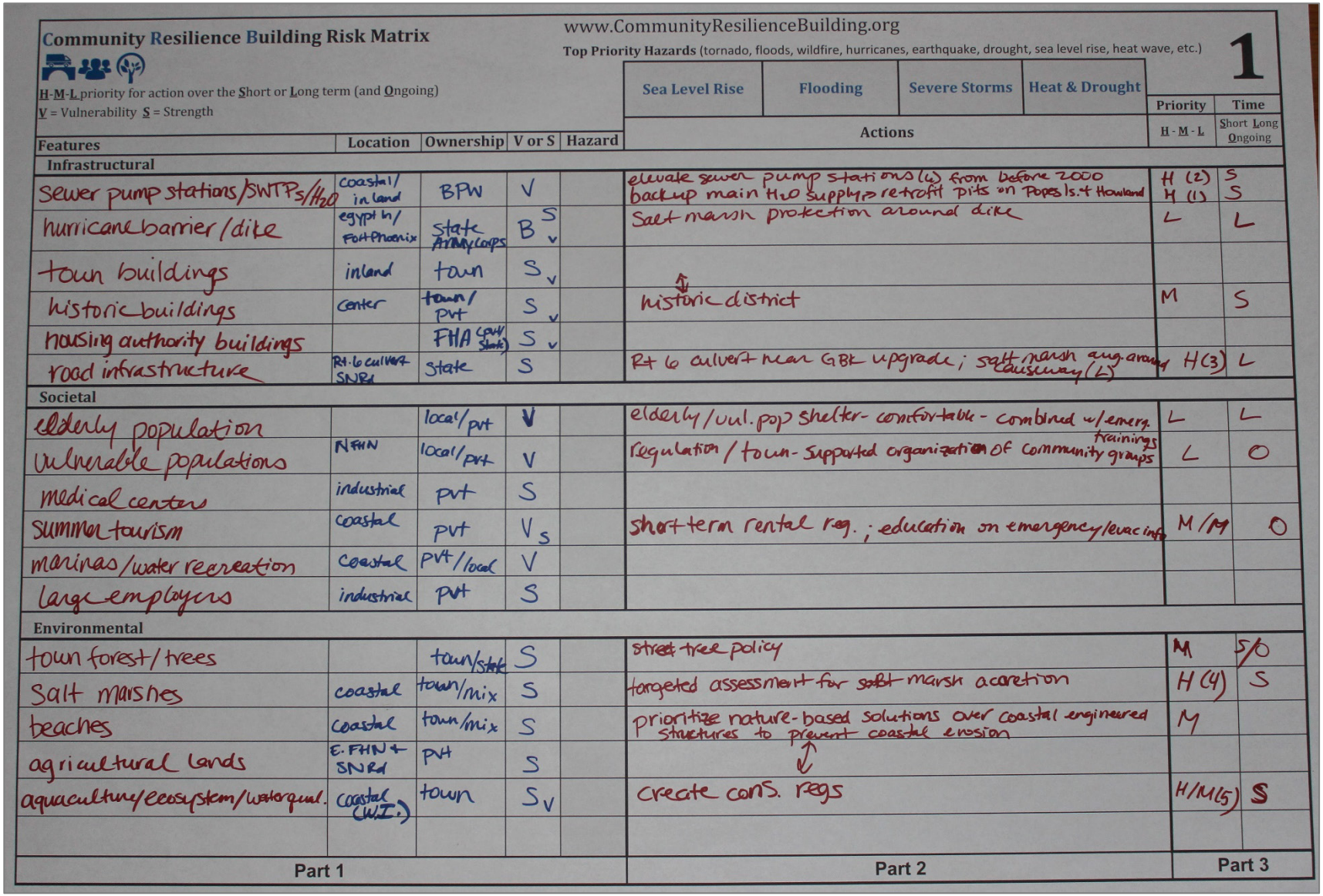
9. Acknowledgements

The Town of Fairhaven would like to thank all of those individuals who served on the Town's MVP Steering Committee and who participated in the CRB Workshop as listed in the previous section. The Town would also like to express its appreciation to the following core team members for their time and dedication to make the entire MVP planning project a success.

- Whitney McClees (MVP Project Manager), Conservation Agent and Sustainability Coordinator, Town of Fairhaven
- Todd Correia, Deputy Fire Chief, Town of Fairhaven
- Tim Cox, Harbormaster, Town of Fairhaven
- Paul Foley, Director of Planning and Economic Development, Town of Fairhaven
- Mary Freire-Kellogg, Health Agent, Town of Fairhaven
- Vincent Furtado, Public Works Superintendent, Town of Fairhaven
- Krisanne Sheedy, Executive Director, Fairhaven Housing Authority
- Jay Simmons, Chairperson, Fairhaven Conservation Commission

The Town of Fairhaven would also like to thank the Massachusetts Executive Office of Energy and Environmental Affairs (EEA) for the financial and technical support provided through Commonwealth's Municipal Vulnerability Preparedness (MVP) program.

Appendix A. CRB Risk Matrices and Maps



Community Resilience Building Risk Matrix — www.CommunityResilienceBuilding.org

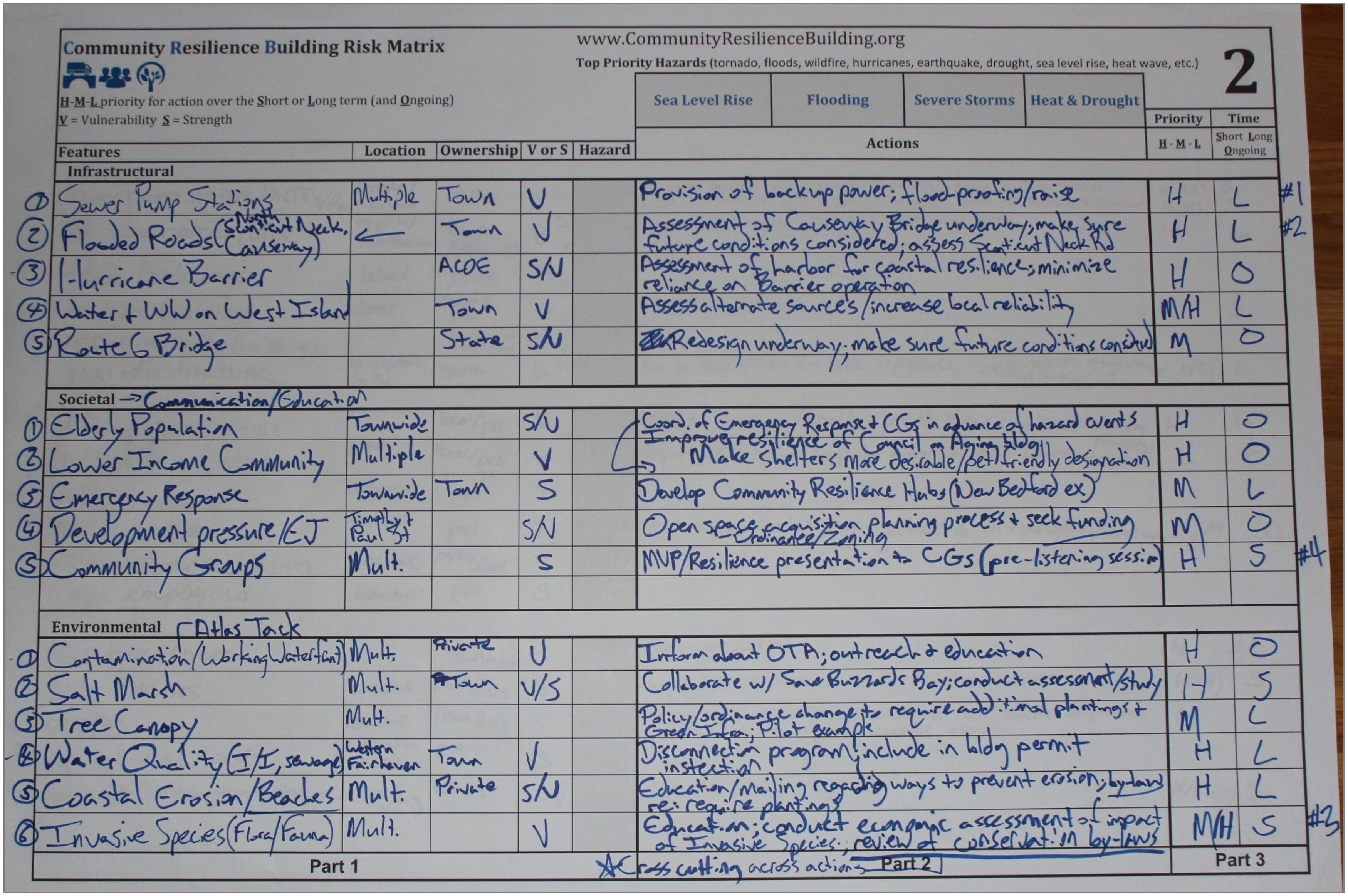
Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.): Sea Level Rise; Flooding; Severe Storms; Heat & Drought

1

H-M-L priority for action over the Short or Long term (and Ongoing)
V = Vulnerability S = Strength

Features	Location	Ownership	V or S	Hazard	Actions	Priority H-M-L	Time Short Long Ongoing
Infrastructural							
sewer pump stations/SWTPs/H_2O	coastal/ inland	BPW	V		elevate sewer pump stations (4) from before 2000 backup main H_2O supply → retrofit pits on Popes Is. & Howland	H (2) H (1)	S S
hurricane barrier/dike	egypt in/ Fort Phoenix	state Army Corps	B S V		salt marsh protection around dike	L	L
town buildings	inland	town	S V				
historic buildings	center	town/ pvt	S V		historic district	M	S
housing authority buildings		FHA (gov't stock)	S V				
road infrastructure	Rt. 6 culvert SNRd	state	S		Rt 6 culvert near GBL upgrade; salt marsh aug. around causeway (L)	H (3)	L
Societal							
elderly population		local/pvt	V		elderly/vul. pop shelter - comfortable - combined w/ emerg. trainings	L	L
vulnerable populations	NFHN	local/pvt	V		regulation / town-supported organization of community groups	L	O
medical centers	industrial	pvt	S				
summer tourism	coastal	pvt	V S		short term rental reg.; education on emergency/evac info	M/M	O
marinas/water recreation	coastal	pvt/local	V				
large employers	industrial	pvt	S				
Environmental							
town forest/trees		town/state	S		street tree policy	M	S/O
salt marshes	coastal	town/mix	S		targeted assessment for salt marsh accretion	H (4)	S
beaches	coastal	town/mix	S		prioritize nature-based solutions over coastal engineered structures to prevent coastal erosion	M	
agricultural lands	E. FHN + SNRd	pvt	S				
aquaculture/ecosystem/waterqual.	coastal (W.I.)	town	S V		create cons. regs	H/M (5)	S

Part 1 | Part 2 | Part 3



Community Resilience Building Risk Matrix www.CommunityResilienceBuilding.org **2**

H-M-L priority for action over the Short or Long term (and Ongoing)
V = Vulnerability S = Strength

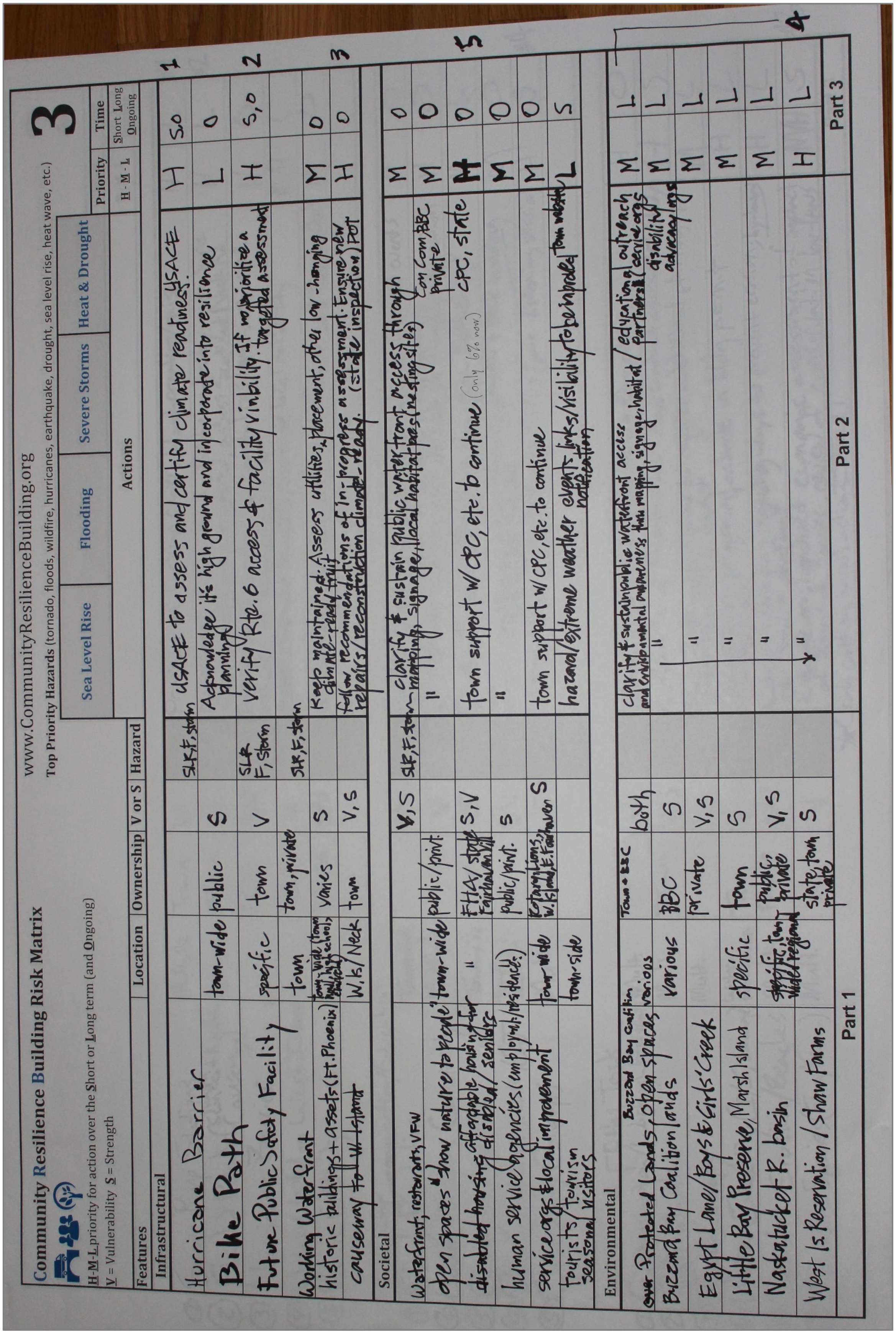
Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Sea Level Rise | Flooding | Severe Storms | Heat & Drought

Features	Location	Ownership	V or S	Hazard	Actions	Priority H-M-L	Time Short Long Ongoing	
Infrastructural								
① Sewer Pump Stations	Multiple	Town	V		Provision of backup power; flood-proofing/raise	H	L	#1
② Flooded Roads (North Sconticut Neck, Causeway)	←	Town	V		Assessment of Causeway Bridge underway; make sure future conditions considered; assess Sconticut Neck Rd	H	L	#2
③ Hurricane Barrier		ACOE	S/V		Assessment of harbor for coastal resilience; minimize reliance on Barrier operation	H	O	
④ Water + WW on West Island		Town	V		Assess alternate sources/increase local reliability	M/H	L	
⑤ Route 6 Bridge		State	S/V		Redesign underway; make sure future conditions considered	M	O	
Societal → Communication/Education								
① Elderly Population	Townwide		S/V		Coord. of Emergency Response + CGs in advance of hazard events	H	O	
② Lower Income Community	Multiple		V		Improve resilience of Council on Aging bldg; Make shelters more desirable/pet friendly designation	H	O	
③ Emergency Response	Townwide	Town	S		Develop Community Resilience Hubs (New Bedford ex)	M	L	
④ Development pressure/EJ	Timothy + Paul St		S/V		Open space acquisition planning process + seek funding — Ordinance/Zoning	M	O	
⑤ Community Groups	Mult.		S		MVP/Resilience presentation to CGs (pre-listening session)	H	S	#4
Environmental [Atlas Tack								
① Contamination (Working Waterfront)	Mult.	Private	V		Inform about OTA; outreach + education	H	O	
② Salt Marsh	Mult.	Town	V/S		Collaborate w/ Save Buzzards Bay; conduct assessment/study	H	S	
③ Tree Canopy	Mult.				Policy/ordinance change to require additional plantings + Green Infra; Pilot example	M	L	
④ Water Quality (I/I, sewage)	Western Fairhaven	Town	V		Disconnection program; include in bldg permit inspection	H	L	
⑤ Coastal Erosion/Beaches	Mult.	Private	S/V		Education/mailing regarding ways to prevent erosion; by-laws re: require plantings?	H	L	
⑥ Invasive Species (Flora/Fauna)	Mult.		V		Education; conduct economic assessment of impact of Invasive Species; review of conservation by-laws	M/H	S	#3

★ Cross cutting across actions

Part 1 | Part 2 | Part 3



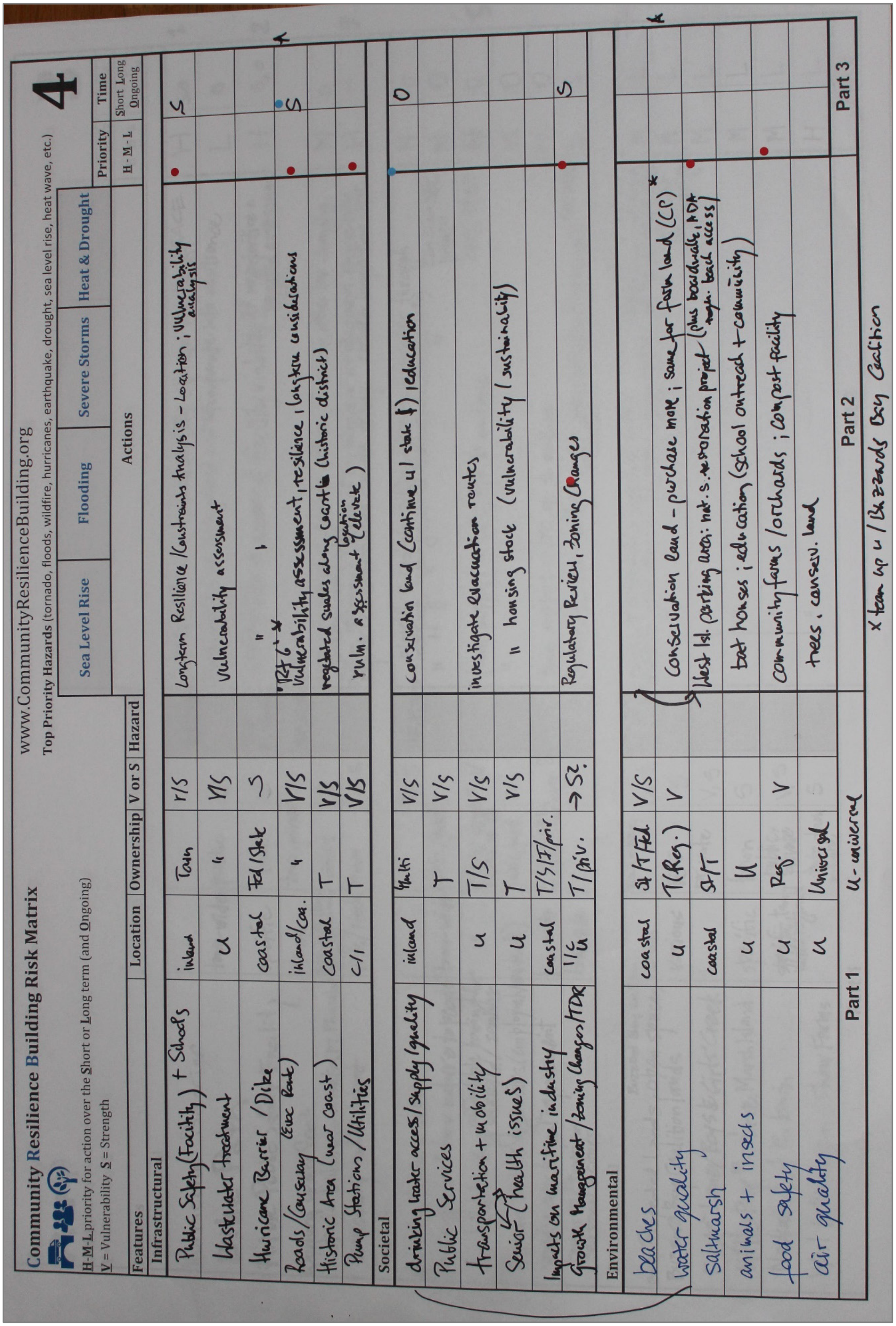
Community Resilience Building Risk Matrix — www.CommunityResilienceBuilding.org — **3**

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Sea Level Rise | Flooding | Severe Storms | Heat & Drought

H-M-L priority for action over the Short or Long term (and Ongoing)
V = Vulnerability S = Strength

Features	Location	Ownership	V or S	Hazard	Actions	Priority H-M-L	Time Short Long Ongoing	
Infrastructural								
Hurricane Barrier				SLR,F,storm	USACE to assess and certify climate readiness. USACE	H	S,O	1
Bike Path	town-wide	public	S		Acknowledge it's high ground and incorporate into resilience planning	L	O	
Future Public Safety Facility	specific	town	V	SLR F, Storm	Verify Rte. 6 access & facility viability. If no, prioritize a targeted assessment	H	S, O	2
Working Waterfront	town	town, private		SLR,F,storm				
historic buildings + assets (Ft. Phoenix)	town-wide (town hall, high school, library)	varies	S		Keep maintained. Assess utilities, placement, other low-hanging climate-ready fruit	M	O	
causeway ~~to W. Island~~	W. Is/Neck	town	V, S		follow recommendations of in-progress assessment. Ensure new repairs/reconstruction climate-ready. (state inspection) DOT	H	O	3
Societal								
Waterfront, restaurants, VFW			V, S	SLR,F,storm	clarify & sustain public waterfront access through mapping, signage, local habitat pres (nesting sites)	M	O	
open spaces "show nature to people"	town-wide	public/privt.			" Con Com, BBC private	M	O	
~~disabled housing~~ affordable housing for disabled/seniors	"	FHA/state Fairhaven Vill	S, V		town support w/ CPC, etc. to continue (only 6% now) CPC, state	H	O	5
human service agencies (employmt/residence)		public/privt.	S		"	M	O	
service orgs & local improvement	town-wide	Rotary, Lions, W. Island, E. Fairhaven	S		town support w/ CPC, etc. to continue	M	O	
tourists/tourism seasonal visitors	town-side				hazard/extreme weather events links/visibility to be improved town website notification	L	S	
Environmental								
~~over~~ Protected Lands, open spaces Buzzard Bay Coalition	various	Town + BBC	both		clarify & sustain public waterfront access and environmental awareness thru mapping, signage, habitat / educational outreach partners & service orgs	M	L	
Buzzard Bay Coalition lands	various	BBC	S		" disability advocacy orgs	M	L	
Egypt Lane/Boys & Girls' Creek		private	V, S		"	M	L	
Little Bay Preserve, Marsh Island	specific	town	S		"	M	L	
Naskatucket R. basin	~~specific~~, town wide/regional	public, private	V, S		"	M	L	
West Is. Reservation / Shaw Farms		state, town private	S		"	H	L	4
Part 1					Part 2	Part 3		



Community Resilience Building Risk Matrix — www.CommunityResilienceBuilding.org — 4

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.): Sea Level Rise | Flooding | Severe Storms | Heat & Drought

H-M-L priority for action over the Short or Long term (and Ongoing)
V = Vulnerability S = Strength

Features	Location	Ownership	V or S	Hazard	Actions	Priority H-M-L	Time Short Long Ongoing
Infrastructural							
Public Safety (Facility) + Schools	inland	Town	V/S		Longterm Resilience / Constraints Analysis – Location; vulnerability analysis	●	S
Wastewater treatment	"	"	V/S		vulnerability assessment		
Hurricane Barrier / Dike	coastal	Fed/State	S		"		
Roads/Causeway (Evac Route)	inland/coa.	"	V/S		"Rt 6" * vulnerability assessment, resilience, longterm considerations	●	S
Historic Area (near coast)	coastal	T	V/S		vegetated swales along coast (historic district)		
Pump Stations / Utilities	c/i	T	V/S		vuln. assessment (location elevate)	●	
Societal							
drinking water access/supply/quality	inland	Multi	V/S		conservation land (continue w/ state $) / education	●	O
Public Services		T	V/S				
transportation + mobility	u	T/S	V/S		investigate evacuation routes		
Senior (health issues)	u	T	V/S		" housing stock (vulnerability / sustainability)		
Impacts on maritime industry	coastal	T/S/F/priv.					
Growth Management / Zoning Changes / TDR	i/c u	T/priv.	→ S?		Regulatory Review, Zoning Changes	●	S
Environmental							
beaches	coastal	St/T/Fed	V/S				
water quality	u	T(Reg.)	V		Conservation land – purchase more; same for farm land (CP) *		
saltmarsh	coastal	St/T			West Isl. parking area: nat. s. restoration project (plus boardwalk, ADA ... beach access)	●	
animals + insects	u	U			bat houses; education (school outreach + community)		
food safety	u	Reg.	V		community farms / orchards; compost facility	●	
air quality	u	Universal			trees, conserv. land		

Part 1 — U - universal — Part 2 — Part 3

X team up w/ Buzzards Bay Coalition

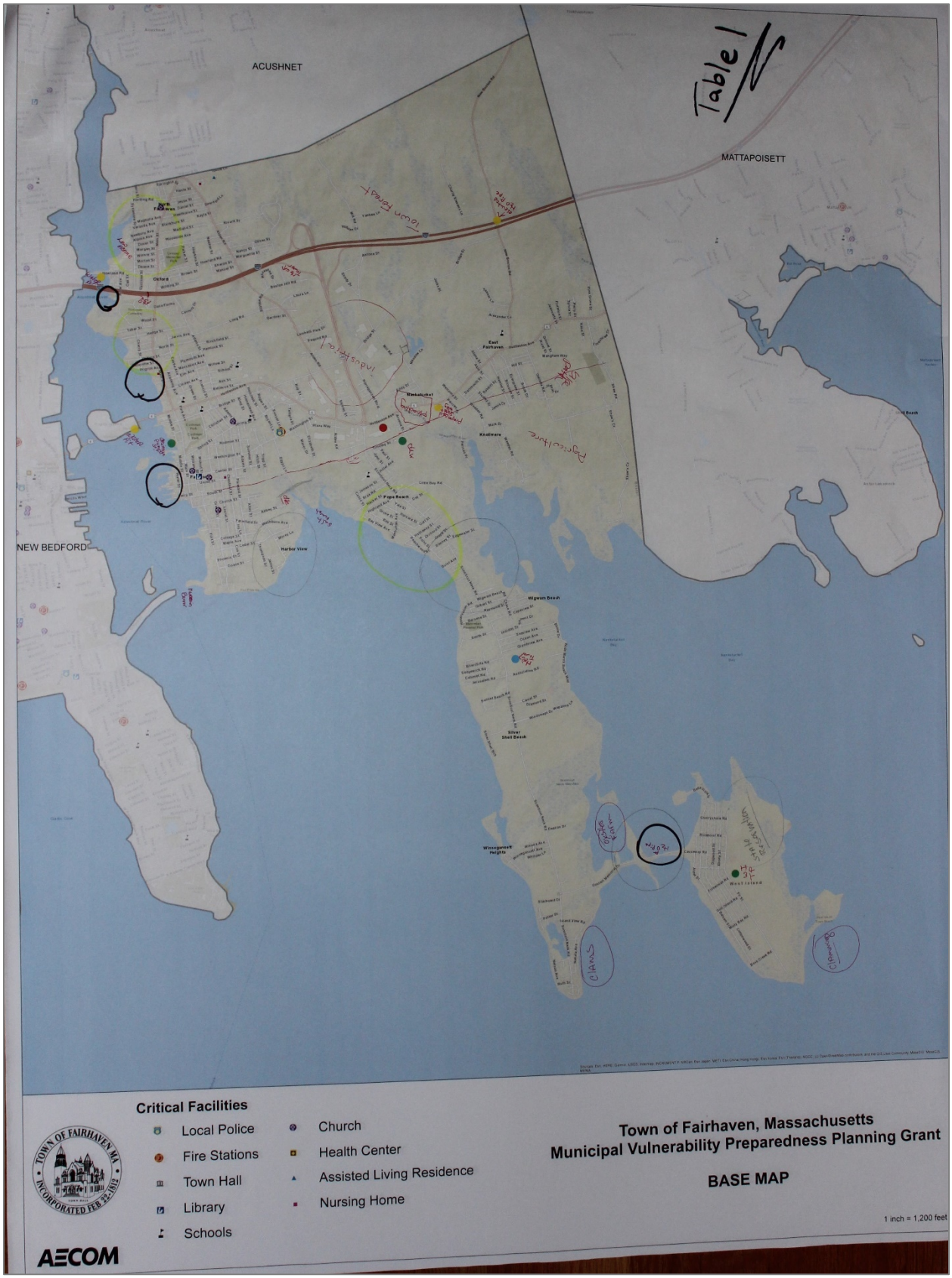
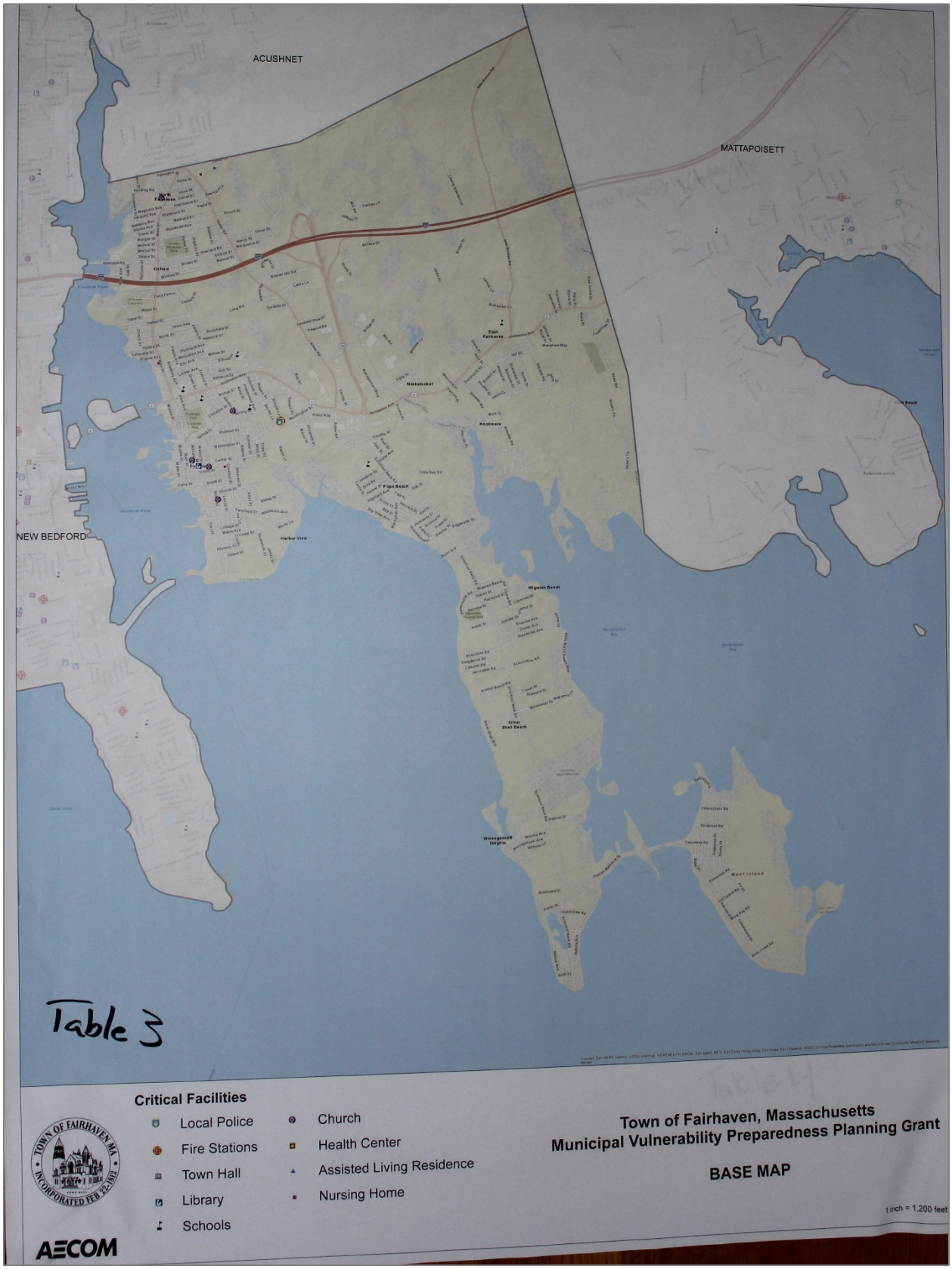
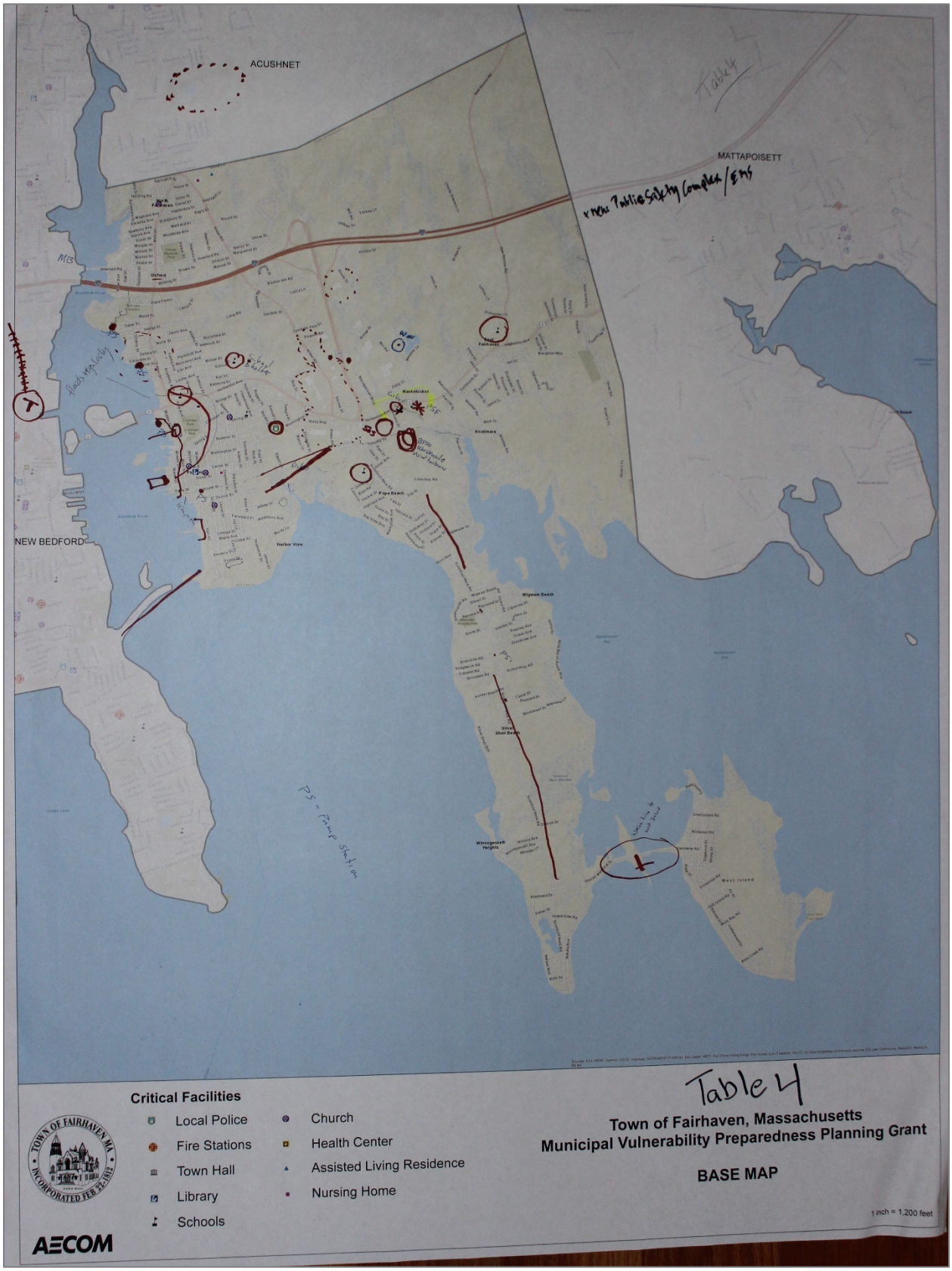


Table 1
ACUSHNET
MATTAPOISETT
NEW BEDFORD
Critical Facilities
Local Police
Fire Stations
Town Hall
Library
Schools
Church
Health Center
Assisted Living Residence
Nursing Home
Town of Fairhaven, Massachusetts
Municipal Vulnerability Preparedness Planning Grant
BASE MAP
1 inch = 1,200 feet
AECOM


Table 2
ACUSHNET
MATTAPOISETT
NEW BEDFORD
Critical Facilities
Local Police
Fire Stations
Town Hall
Library
Schools
Church
Health Center
Assisted Living Residence
Nursing Home
Town of Fairhaven, Massachusetts
Municipal Vulnerability Preparedness Planning Grant
BASE MAP
1 inch = 1,200 feet
AECOM


ACUSHNET
MATTAPOISETT
NEW BEDFORD
Table 3
Critical Facilities
Local Police
Fire Stations
Town Hall
Library
Schools
Church
Health Center
Assisted Living Residence
Nursing Home
Town of Fairhaven, Massachusetts
Municipal Vulnerability Preparedness Planning Grant
BASE MAP
1 inch = 1,200 feet
AECOM


ACUSHNET
MATTAPOISETT
NEW BEDFORD
Table 4
Critical Facilities
Local Police
Fire Stations
Town Hall
Library
Schools
Church
Health Center
Assisted Living Residence
Nursing Home
Town of Fairhaven, Massachusetts
Municipal Vulnerability Preparedness Planning Grant
BASE MAP
1 inch = 1,200 feet
AECOM

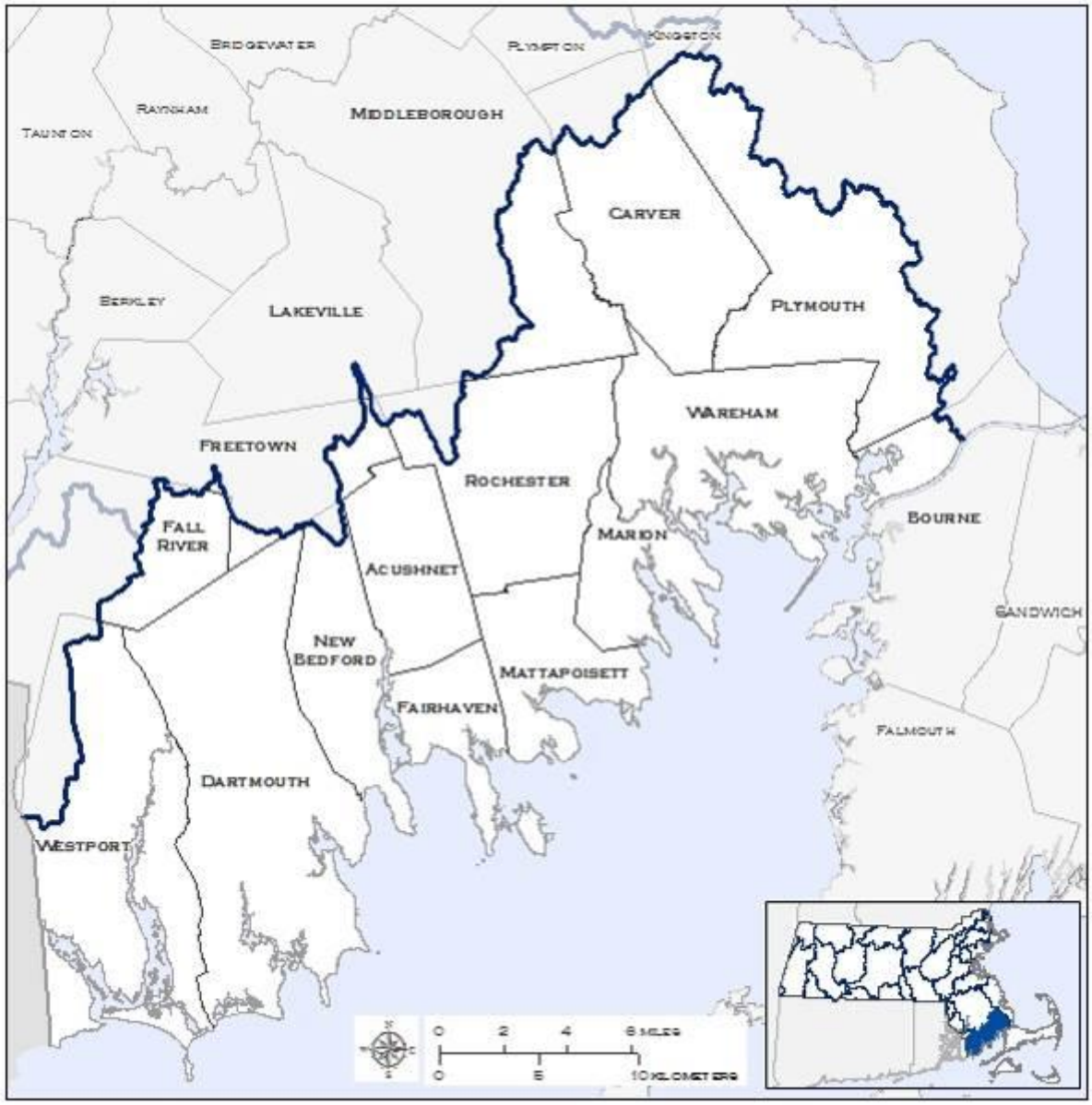
Appendix B. Climate Projections for Buzzards Bay Basin

MASSACHUSETTS CLIMATE CHANGE PROJECTIONS

BUZZARDS BAY BASIN

MUNICIPALITIES WITHIN BUZZARDS BAY BASIN:

Acushnet, Bourne, Carver, Dartmouth, Fairhaven, Fall River, Freetown, Lakeville, Marion, Mattapoisett, Middleborough, New Bedford, Plymouth, Rochester, Wareham, Westport



Many municipalities fall within more than one basin, so it is advised to use the climate projections for the basin that contains the majority of the land area of the municipality.

BUZZARDS BAY BASIN

Buzzards Bay Basin		Observed Baseline 1971-2000 (°F)	Projected Change in 2030s (°F)	Mid-Century Projected Change in 2050s (°F)	Projected Change in 2070s (°F)	End of Century Projected Change in 2090s (°F)
Average Temperature	Annual	50.7	+1.9 to +3.6	+2.6 to +5.9	+3.0 to +8.5	+3.3 to +10.3
	Winter	31.3	+2.1 to +4.2	+2.8 to +6.4	+3.3 to +8.5	+3.6 to +9.8
	Spring	47.3	+1.9 to +3.6	+2.6 to +5.7	+2.8 to +7.6	+3.3 to +9.2
	Summer	70.1	+1.6 to +3.7	+2.1 to +6.1	+2.6 to +9.4	+3.1 to +11.2
	Fall	53.6	+2.0 to +4.1	+3.2 to +6.1	+3.0 to +8.7	+3.5 to +10.7
Maximum Temperature	Annual	59.5	+1.8 to +3.6	+2.4 to +5.8	+2.7 to +8.5	+3.0 to +10.2
	Winter	39.7	+1.8 to +4.0	+2.4 to +5.9	+2.9 to +7.8	+3.3 to +9.1
	Spring	56.3	+1.8 to +3.5	+2.2 to +5.4	+2.7 to +7.6	+3.2 to +9.1
	Summer	79.2	+1.5 to +3.6	+1.9 to +6.1	+2.5 to +9.3	+2.9 to +11.2
	Fall	62.6	+1.9 to +4.1	+3.0 to +6.2	+2.9 to +8.6	+3.3 to +10.9
Minimum Temperature	Annual	41.8	+2.0 to +3.7	+2.8 to +6.0	+3.2 to +8.5	+3.6 to +10.4
	Winter	22.8	+2.4 to +4.4	+3.1 to +6.9	+3.7 to +9.1	+4.0 to +10.5
	Spring	38.4	+1.9 to +3.7	+2.9 to +5.9	+2.8 to +7.8	+3.4 to +9.2
	Summer	61.1	+1.7 to +3.8	+2.2 to +6.2	+2.7 to +9.3	+3.4 to +11.3
	Fall	44.7	+2.0 to +4.3	+3.3 to +6.1	+3.1 to +8.8	+3.7 to +10.7

- The Buzzards Bay basin is expected to experience increased average temperatures throughout the 21st century. Maximum and minimum temperatures are also expected to increase throughout the end of the century. These increased temperature trends are expected for annual and seasonal projections.
- Seasonally, maximum summer and fall temperatures are expected to see the highest projected increase throughout the 21st century.
    - Summer mid-century increase of 1.9 °F to 6.1 °F (2-8% increase); end of century increase of 2.9 °F to 11.2 °F (4-14% increase).
    - Fall mid-century increase of 3.0 °F to 6.2°F (5-10% increase); end of century increase by and 3.3 °F to 10.9 °F (5-17% increase).
- Seasonally, minimum winter and fall temperatures are expected to see increases throughout the 21st century.
    - Winter mid-century increase of 3.1 °F to 6.9 °F (14-30% increase); end of century increase by 4.0 °F to 10.5 °F (18-46% increase).
    - Fall mid-century of 3.3 °F to 6.1 °F (7-14% increase); end of century increase of 3.7 °F to 10.7 °F (8-24% increase).

BUZZARDS BAY BASIN

Buzzards Bay Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Maximum Temperature Over 90°F	Annual	4	+3 to +9	+4 to +21	+6 to +40	+8 to +55
	Winter	0	+0 to +0	+0 to +0	+0 to +0	+0 to +0
	Spring	<1[32]	+0 to +<1[32]	+<1[32] to +3	+<1[32] to +1	+<1[32] to +1
	Summer	4	+3 to +8	+4 to +19	+6 to +35	+7 to +48
	Fall	<1[32]	+<1[32] to +1	+<1[32] to +2	+<1[32] to +4	+1 to +6
Days with Maximum Temperature Over 95°F	Annual	1	+1 to +3	+1 to +6	+1 to +15	+2 to +25
	Winter	0	+0 to +0	+0 to +0	+0 to +0	+0 to +0
	Spring	<1[32]	+0 to +<1[32]	+0 to +<1[32]	+<1[32] to +<1[32]	+<1[32] to +<1[32]
	Summer	1	+1 to +2	+1 to +6	+1 to +14	+2 to +24
	Fall	0	+0 to +<1[32]	+<1[32] to +<1[32]	+<1[32] to +1	+<1[32] to +1
Days with Maximum Temperature Over 100°F	Annual	<1[32]	+<1[32] to +<1[32]	+<1[32] to +1	+<1[32] to +3	+<1[32] to +7
	Winter	0	+0 to +0	+0 to +0	+0 to +0	+0 to +0
	Spring	0	+0 to +<1[32]	+0 to +<1[32]	+0 to +<1[32]	+0 to +<1[32]
	Summer	<1[32]	+<1[32] to +<1[32]	+<1[32] to +1	+<1[32] to +3	+<1[32] to +7
	Fall	0	+0 to +<1[32]	+0 to +<1[32]	+0 to +<1[32]	+0 to +<1[32]

- Due to projected increases in average and maximum temperatures throughout the end of the century, the Buzzards Bay basin is also expected to experience an increase in days with daily maximum temperatures over 90 °F, 95 °F, and 100 °F.
    - Annually, the Buzzards Bay basin is expected to see days with daily maximum temperatures over 90 °F increase by 4 to 21 more days by mid-century, and 8 to 55 more days by the end of the century.
    - Seasonally, summer is expected to see an increase of 4 to 19 more days with daily maximums over 90 °F by mid-century.
    - By end of century, the Buzzards Bay basin is expected to have 7 to 48 more days.

[32] Over the observed period, there were some years with at least 1 day with seasonal Tmax over a certain threshold while in all the other years that threshold wasn't crossed seasonally at all.

BUZZARDS BAY BASIN

Buzzards Bay Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Minimum Temperature Below 0°F	Annual	2	-0 to -1	-0 to -1	-0 to -1	-0 to -1
	Winter	2	-0 to -1	-0 to -1	-0 to -1	-0 to -1
	Spring	0	-0 to -0	-0 to -0	-0 to -0	-0 to -0
	Summer	0	-0 to -0	-0 to -0	-0 to -0	-0 to -0
	Fall	0	-0 to -0	-0 to -0	-0 to -0	-0 to -0
Days with Minimum Temperature Below 32°F	Annual	111	-14 to -28	-20 to -44	-23 to -55	-24 to -67
	Winter	73	-5 to -12	-7 to -20	-9 to -29	-10 to -37
	Spring	25	-5 to -11	-7 to -15	-8 to -18	-9 to -19
	Summer	0	-0 to -0	-0 to -0	-0 to -0	-0 to -0
	Fall	13	-0 to -7	-0 to -9	-0 to -11	-0 to -12

- Due to projected increases in average and minimum temperatures throughout the end of the century, the Buzzards Bay basin is expected to experience a decrease in days with daily minimum temperatures below 32 °F and 0 °F.
- Seasonally, winter, spring and fall are expected to see the largest decreases in days with daily minimum temperatures below 32 °F.
    - Winter is expected to have 7 to 20 fewer days by mid-century, and 10 to 37 fewer by end of century.
    - Spring is expected to have 7 to 15 fewer days by mid-century, and 9 to 19 fewer by end of century.
    - Fall is expected to have 5 to 9 fewer days by mid-century, and 6 to 12 fewer days by end of century.

BUZZARDS BAY BASIN

Buzzards Bay Basin		Observed Baseline 1971-2000 (Degree-Days)	Projected Change in 2030s (Degree-Days)	Mid-Century Projected Change in 2050s (Degree-Days)	Projected Change in 2070s (Degree-Days)	End of Century Projected Change in 2090s (Degree-Days)
Heating Degree-Days (Base 65°F)	Annual	5866	-502 to -972	-707 to -1455	-812 to -1927	-879 to -2283
	Winter	3056	-190 to -383	-247 to -590	-294 to -765	-327 to -905
	Spring	1639	-161 to -308	-217 to -480	-241 to -625	-297 to -728
	Summer	67	-23 to -44	-33 to -54	-34 to -63	-39 to -66
	Fall	1101	-133 to -291	-234 to -400	-223 to -564	-241 to -638
Cooling Degree-Days (Base 65°F)	Annual	622	+191 to +404	+242 to +683	+284 to +1120	+348 to +1423
	Winter	0	+0 to +4	+0 to +4	-1 to +4	+1 to +5
	Spring	16	+9 to +25	+13 to +48	+15 to +78	+16 to +104
	Summer	537	+120 to +303	+153 to +512	+200 to +795	+246 to +972
	Fall	67	+31 to +87	+47 to +160	+54 to +251	+81 to +330
Growing Degree-Days (Base 50°F)	Annual	2734	+363 to +753	+486 to +1199	+558 to +1890	+655 to +2361
	Winter	7	+1 to +14	+2 to +22	+6 to +38	+7 to +54
	Spring	280	+73 to +144	+96 to +246	+102 to +369	+110 to +479
	Summer	1850	+143 to +342	+188 to +564	+235 to +860	+287 to +1034
	Fall	593	+99 to +263	+179 to +411	+170 to +603	+219 to +765

- Due to projected increases in average, maximum, and minimum temperatures throughout the end of the century, the Buzzards Bay basin is expected to experience a decrease in heating degree-days, and increases in both cooling degree-days and growing degree-days.
- Seasonally, winter historically exhibits the highest number of heating degree-days and is expected to see the largest decrease of any season, but spring and fall are also expected to see significant change.
    - The winter season is expected to see a decrease of 247 to 590 degree-days by mid-century (a decrease of 8-19%), and a decrease of 327 to 905 degree-days by the end of century (a decrease of 11-30%).
    - The spring season is expected to decrease in heating degree-days by 13-29% (217-480 degree-days) by mid-century, and by 18-44% (297-728 degree-days) by the end of century.
    - The fall season is expected to decreases in heating degree-days by 21-36% (234-400 degree-days) by mid-century, and by and 22-58% (241-638 degree-days) by the end of century.
- Conversely, due to projected increasing temperatures, summer cooling degree-days are expected to increase by 28-95% (153-512 degree-days) by mid-century, and by 46-181% (246-972 degree-days) by end of century.

- Seasonally, summer historically exhibits the highest number of growing degree-days and is expected to see the largest decrease of any season, but the shoulder seasons of spring and fall are also expected to see an increase in growing degree-days.
    - The summer season is projected to increase by 10-30% (188-564 degree-days) by mid-century, and by 16-56% (287-1034 degree-days) by end of century.
    - Spring is expected to see an increase by 34-88% (96-246 degree-days) by mid-century and 39-171% (110-479 degree-days) by end of century.
    - Fall is expected to see an increase by 30-69% (179-411 degree-days) by mid-century and 37-129% (219-765 degree-days) by end of century.

BUZZARDS BAY BASIN

Buzzards Bay Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Days with Precipitation Over 1"	Annual	8	+<1[34] to +2	+1 to +3	+1 to +3	+1 to +4
	Winter	2	+<1[34] to +1	+<1[34] to +1	+<1[34] to +1	+<1[34] to +2
	Spring	2	+<1[34] to +1	+<1[34] to +1	+<1[34] to +1	+<1[34] to +1
	Summer	2	+0 to +1	+0 to +1	+0 to +1	+0 to +1
	Fall	2	+0 to +1	+0 to +1	+0 to +1	+0 to +1
Days with Precipitation Over 2"	Annual	1	+<1[34] to +1	+<1[34] to +1	+<1[34] to +1	+<1[34] to +1
	Winter	<1[33]	+0 to +<1[34]	+<1[34] to +<1[34]	+0 to +<1[34]	+<1[34] to +<1[34]
	Spring	<1[34]	+0 to +<1[34]	+0 to +<1[34]	+<1[34] to +<1[34]	+<1[34] to +<1[34]
	Summer	<1[34]	+0 to +<1[34]	+0 to +<1[34]	+0 to +<1[34]	+0 to +<1[34]
	Fall	<1[34]	+0 to +<1[34]	+<1[34] to +<1[34]	+0 to +<1[34]	+0 to +<1[34]
Days with Precipitation Over 4"	Annual	<1[34]	+0 to +<1[34]	+0 to +<1[34]	+0 to +<1[34]	+0 to +<1[34]
	Winter	0	+0 to +<1[34]	+0 to +<1[34]	+0 to +<1[34]	+0 to +<1[34]
	Spring	0	+0 to +<1[34]	+0 to +<1[34]	+0 to +<1[34]	+0 to +<1[34]
	Summer	<1[34]	+0 to +<1[34]	+0 to +<1[34]	+0 to +<1[34]	+0 to +<1[34]
	Fall	<1[34]	+0 to +<1[34]	+0 to +<1[34]	+0 to +<1[34]	+0 to +<1[34]

- The projections for expected number of days receiving precipitation over one inch are variable for the Buzzards Bay basin, fluctuating between loss and gain of days.
    - Seasonally, the winter season is generally expected to see the highest projected increase.
    - The winter season is expected to see an increase in days with precipitation over one inch of 0-1 days by mid-century, and by 0-2 days by the end of century.
    - The spring season is expected to see an increase in days with precipitation over one inch of 0-1 days by mid-century, and by 0-1 days by the end of century.

[33] Over the observed period, there were some years with at least 1 day with seasonal precipitation over a certain threshold while in all the other years that threshold wasn't crossed seasonally at all.

BUZZARDS BAY BASIN

Buzzards Bay Basin		Observed Baseline 1971-2000 (Inches)	Projected Change in 2030s (Inches)	Mid-Century Projected Change in 2050s (Inches)	Projected Change in 2070s (Inches)	End of Century Projected Change in 2090s (Inches)
Total Precipitation	Annual	47.8	-0.7 to +3.9	+0.3 to +5.4	+0.7 to +6.1	+0.3 to +6.8
	Winter	12.6	-0.3 to +1.6	-0.0 to +1.9	+0.2 to +2.6	+0.1 to +3.9
	Spring	12.2	-0.1 to +1.9	-0.1 to +2.2	+0.1 to +2.4	+0.1 to +2.7
	Summer	11.0	-1.0 to +1.1	-0.9 to +1.5	-1.0 to +1.9	-2.3 to +1.8
	Fall	12.1	-0.7 to +0.8	-1.0 to +1.5	-1.6 to +1.7	-1.7 to +1.2

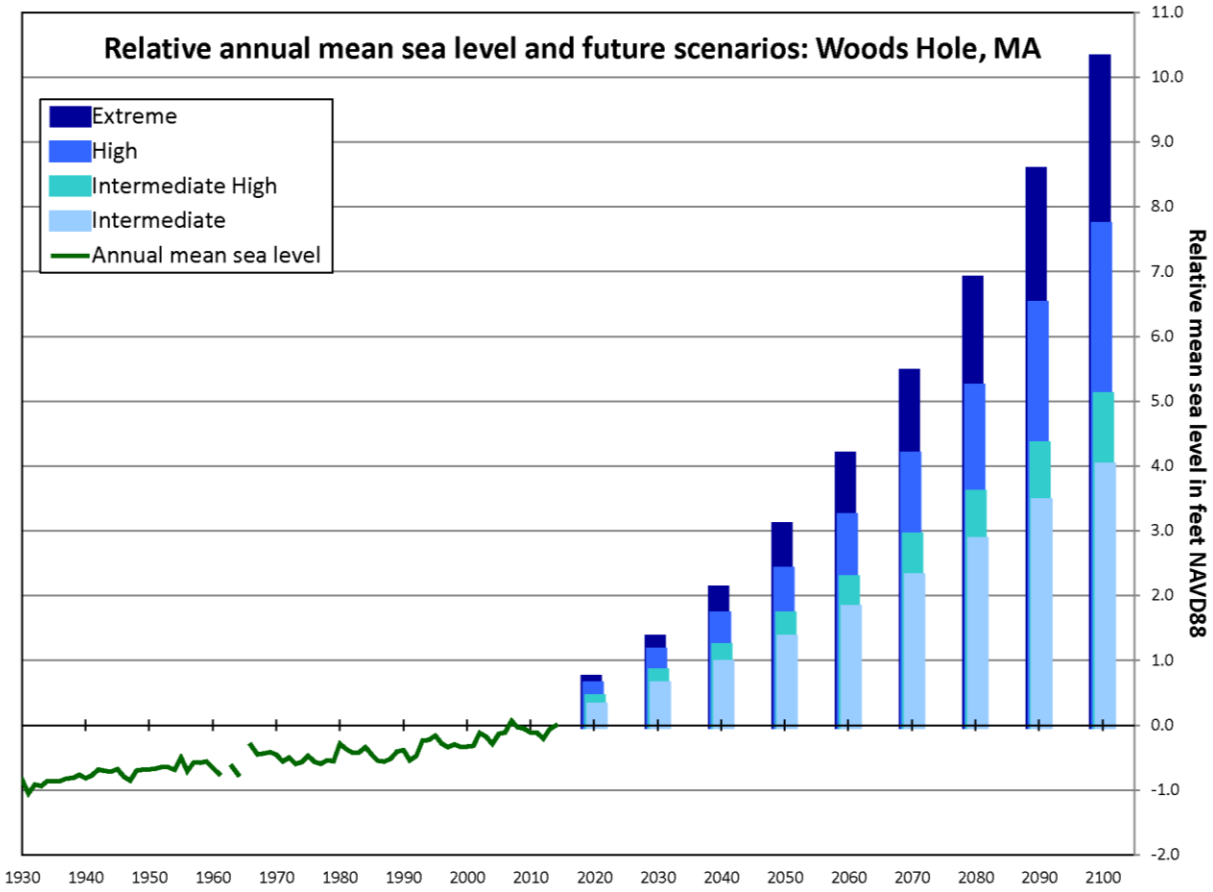
- Similar to projections for number of days receiving precipitation over a specified threshold, seasonal projections for total precipitation are also variable for the Buzzards Bay basin.
    - The winter season is expected to experience the greatest change with an increase of 0-15% by mid-century, and 1-31% by end of century.
    - Projections for the summer and fall seasons are more variable, and could see either a drop or increase in total precipitation throughout the 21st century.
        - The summer season projections for the Buzzards Bay or basin could see a decrease of 0.9 to an increase of 1.5 inches by mid-century (decrease of 8% to increase of 14%), and a decrease of 2.3 to an increase of 1.8 inches by the end of the century (decrease of 21% to increase of 17%).
        - The fall season projections for the Buzzards Bay basin could see a decrease of 1.0 to an increase of 1.5 inches by mid-century (decrease of 8% to increase of 13%), and a decrease of 1.7 to an increase of 1.2 inches by the end of the century (decrease of 14% to increase of 10%).

Buzzards Bay Basin		Observed Baseline 1971-2000 (Days)	Projected Change in 2030s (Days)	Mid-Century Projected Change in 2050s (Days)	Projected Change in 2070s (Days)	End of Century Projected Change in 2090s (Days)
Consecutive Dry Days	Annual	17	+0 to +2	+0 to +2	-1 to +3	+0 to +4
	Winter	10	-1 to +2	-1 to +1	+0 to +2	-1 to +2
	Spring	11	-1 to +1	-1 to +1	-1 to +1	-1 to +1
	Summer	14	-1 to +2	-1 to +2	-1 to +3	+0 to +3
	Fall	13	+0 to +2	+0 to +3	+0 to +3	+0 to +3

- Annual and seasonal projections for consecutive dry days, or for a given period, the largest number of consecutive days with precipitation less than 1 mm (~0.04 inches), are variable throughout the 21st century.
    - For all the temporal parameters, the Buzzards Bay basin is expected to see a slight decrease to an increase in consecutive dry days throughout this century.
    - Seasonally, the fall and summer seasons are expected to continue to experience the highest number of consecutive dry days.
        - The summer season is expected to experience an increase of 0-4 days in consecutive dry days by the end of the century.

Table 8, Figure 2: Relative (or local) mean sea level projections for the Woods Hole, MA tide station based on four National Climate Assessment global scenarios with associated probabilistic model outputs from the Northeast Climate Science Center. Each of the scenarios—Intermediate, Intermediate-High, High, and Extreme—is cross-walked with two to three probabilistic model outputs. Modeling considered two future concentrations of greenhouse gas emissions (referred to as representative concentration pathways [RCP]) and two methods of accounting for Antarctic ice sheet contributions to sea level rise. A 19-year reference time period for sea level (tidal epoch) centered on the year 2000 was used to minimize biases caused by tidal, seasonal, and inter-annual climate variability. Sea level projections for the Woods Hole tide station are referenced to the North American Vertical Datum of 1988 (NAVD88).

Relative mean sea level (feet NAVD88) for Woods Hole, MA					
Scenario	**Probabilistic projections**	**2030**	**2050**	**2070**	**2100**
Intermediate	Unlikely to exceed (83% probability) given a high emissions pathway (RCP 8.5)	0.6	1.3	2.3	4.0
Intermediate- High	Extremely unlikely to exceed (95% probability) given a high emissions pathway (RCP 8.5)	0.8	1.7	2.9	5.1
High	Extremely unlikely to exceed (99.5% probability) given a high emissions pathway (RCP 8.5)	1.1	2.4	4.2	7.7
Extreme (Maximum physically plausible)	Exceptionally unlikely to exceed (99.9% probability) given a high emissions pathway (RCP 8.5)	1.3	3.1	5.4	10.3



Appendix C. Supporting Risk Maps

HELPFUL MAPS

Town of Fairhaven

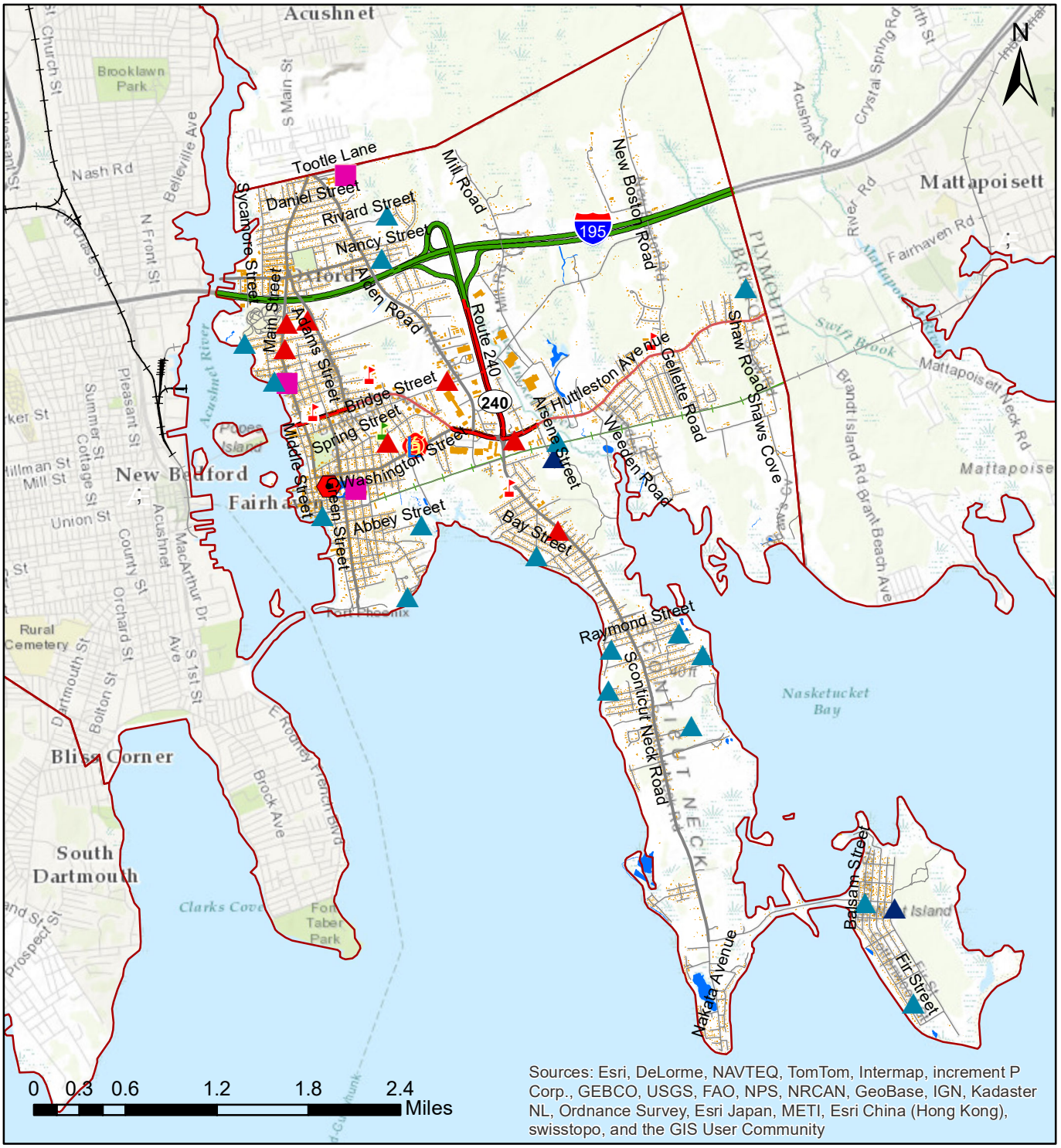
Community **R**esilience **B**uilding Workshop

January 16, 2020

- Base Map with Critical Facilities (C-3)
- Existing Land Use Pattern (C-4)
- Zoning (C-5)
- Special Flood Hazard Areas (C-6)
- Potential Sea Level Rise Inundation (C-7)
- Potential Expansion of Flood Hazard Areas Due to Sea Level Rise (C-8)
- Hurricane Storm Surge Inundation Areas (C-9)
- Repetitive Loss Areas (C-10)
- Long-Term Shoreline Change (C-11)
- Wildfire Hazard Areas (C-12)

** As pulled from the Town of Fairhaven's 2018 Hazard Mitigation Plan*

Town of Fairhaven - Base Map



Legend

- Town Boundary
- Rivers and Lakes
- Building Footprint

Critical Facilities

- Town Hall
- Fire Stations
- Local Police
- Other Critical Facilities
- Sewer Pump Station
- Sewer Wastewater Treatment Plant

Schools (PK - High School)

- Public School
- Private School
- Public Library

Long Term Care Residences

- Nursing Home
- Rail track (used for Hiking and Biking)

All Roads

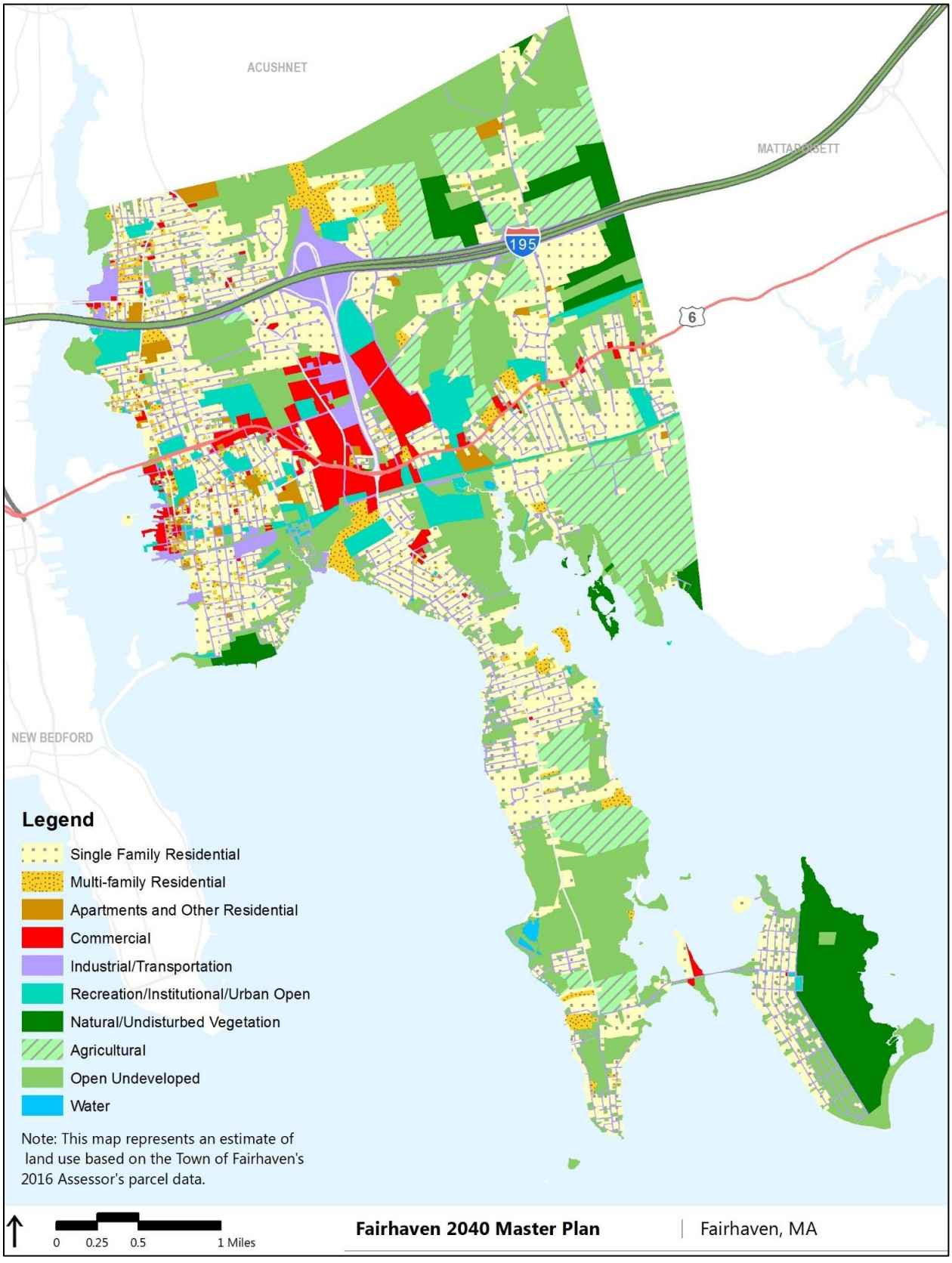
Road Classification

- Limited Access Highway
- Multi-lane Hwy, not limited access
- Other Numbered Highway
- Major Road, Collector
- Minor Road, Arterial

C-3

Source: MassGIS, PeopleGIS

Figure 3-1: Existing Land Use Pattern, 2016



Source: Town of Fairhaven Master Plan, 2017 Draft (prepared by VHB)

Figure 3-2: Town of Fairhaven Zoning Map

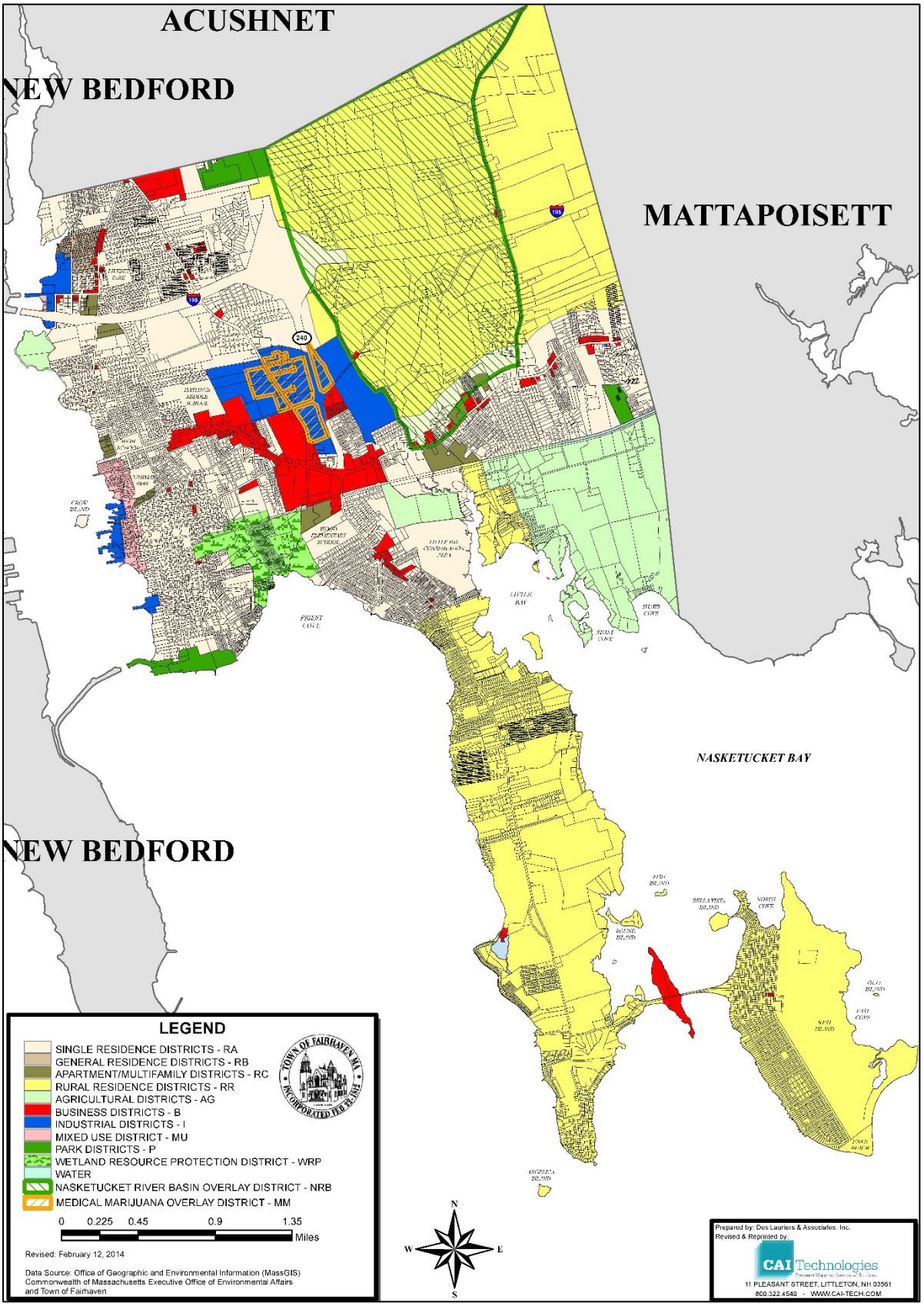
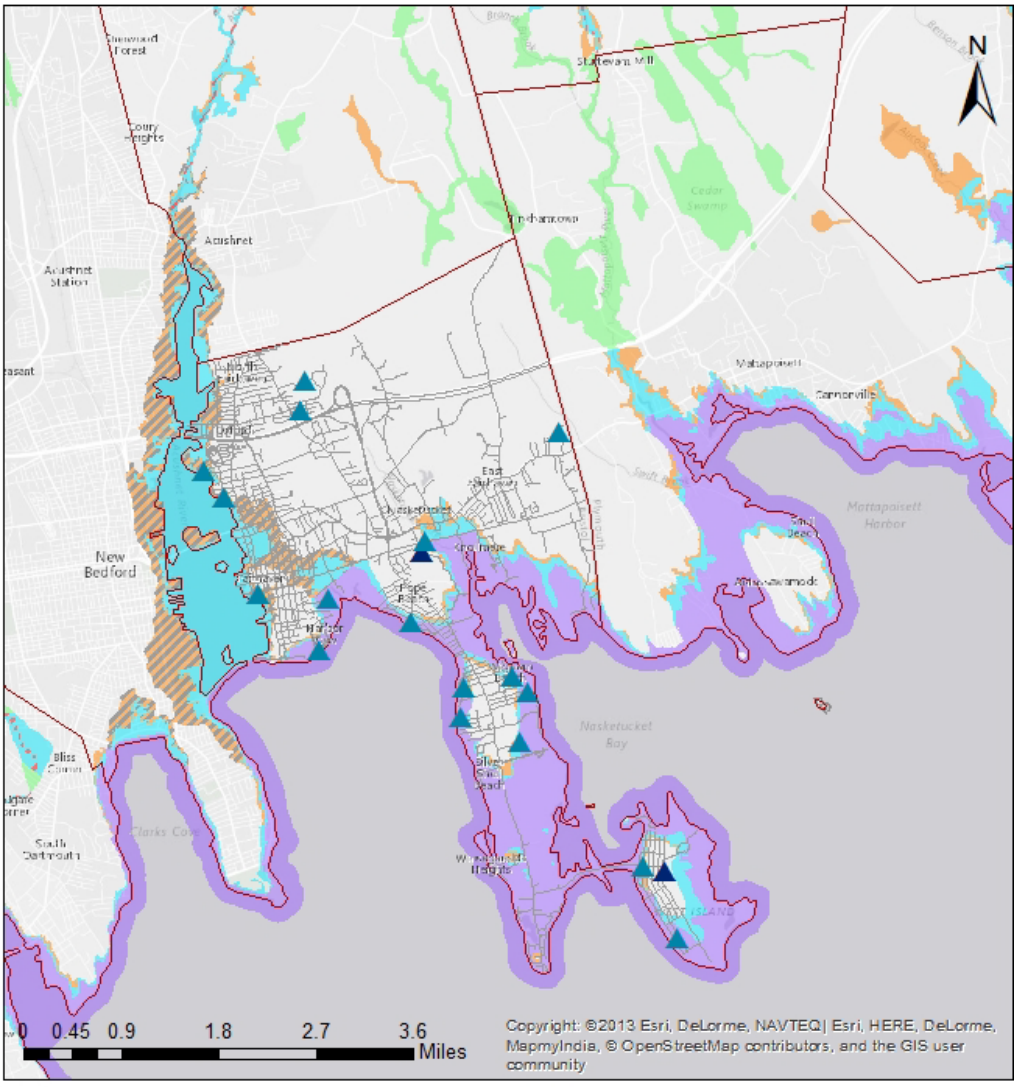


Figure A-11: Special Flood Hazard Areas



Legend

- Roads
- Sewer Pump Station
- Sewer Wastewater Treatment Plant

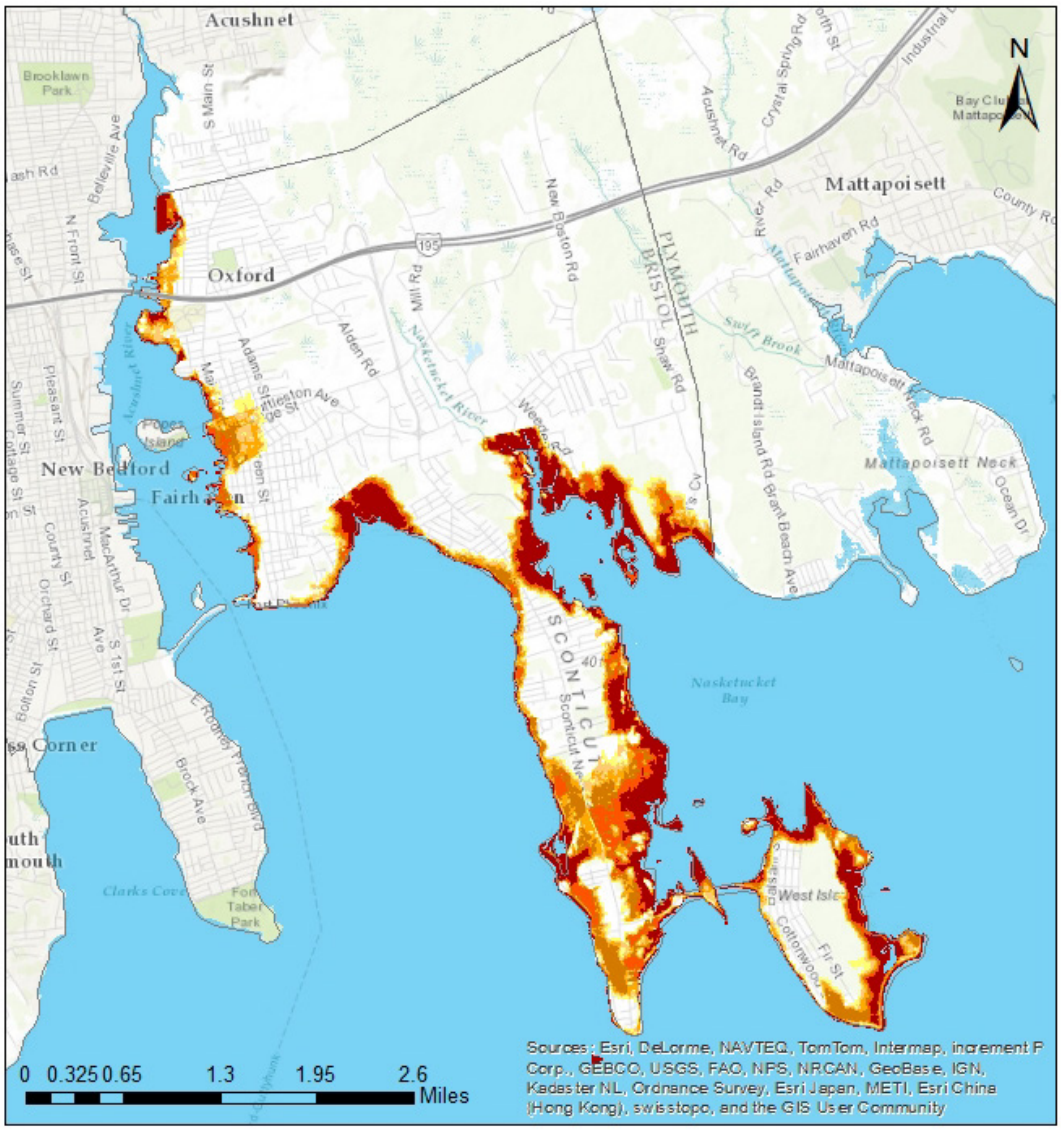
FEMA National Flood Hazard Layer

Flood Zone Designations

- A: 1% Annual Chance of Flooding, no BFE
- AE: 1% Annual Chance of Flooding, with BFE
- AE: Regulatory Floodway
- AH: 1% Annual Chance of 1-3ft Ponding, with Bl
- VE: High Risk Coastal Area
- X: 0.2% Annual Chance of Flooding
- X: Reduced Flood Risk due to Levee

Source: FEMA, People GIS

Figure A-3: Potential Sea Level Rise Inundation

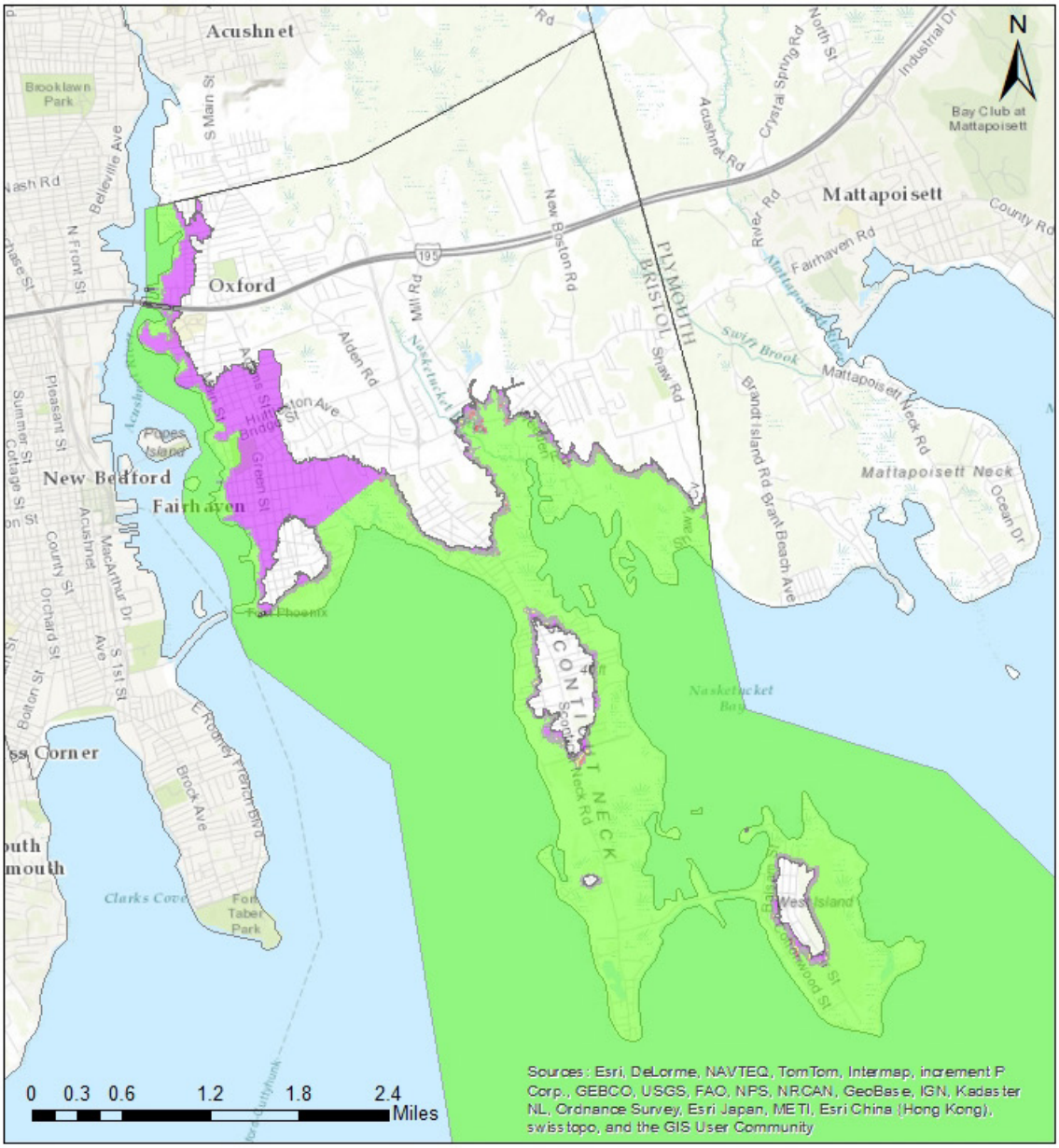


Legend

- Current Mean Higher High Water
- 1 ft Sea Level Rise
- 2 ft Sea Level Rise
- 3 ft Sea Level Rise
- 4 ft Sea Level Rise
- 5 ft Sea Level Rise
- 6 ft Sea Level Rise
- Town Boundary

Source: NOAA

Figure A-4: Potential Expansion of Flood Hazard Areas Due to Sea Level Rise

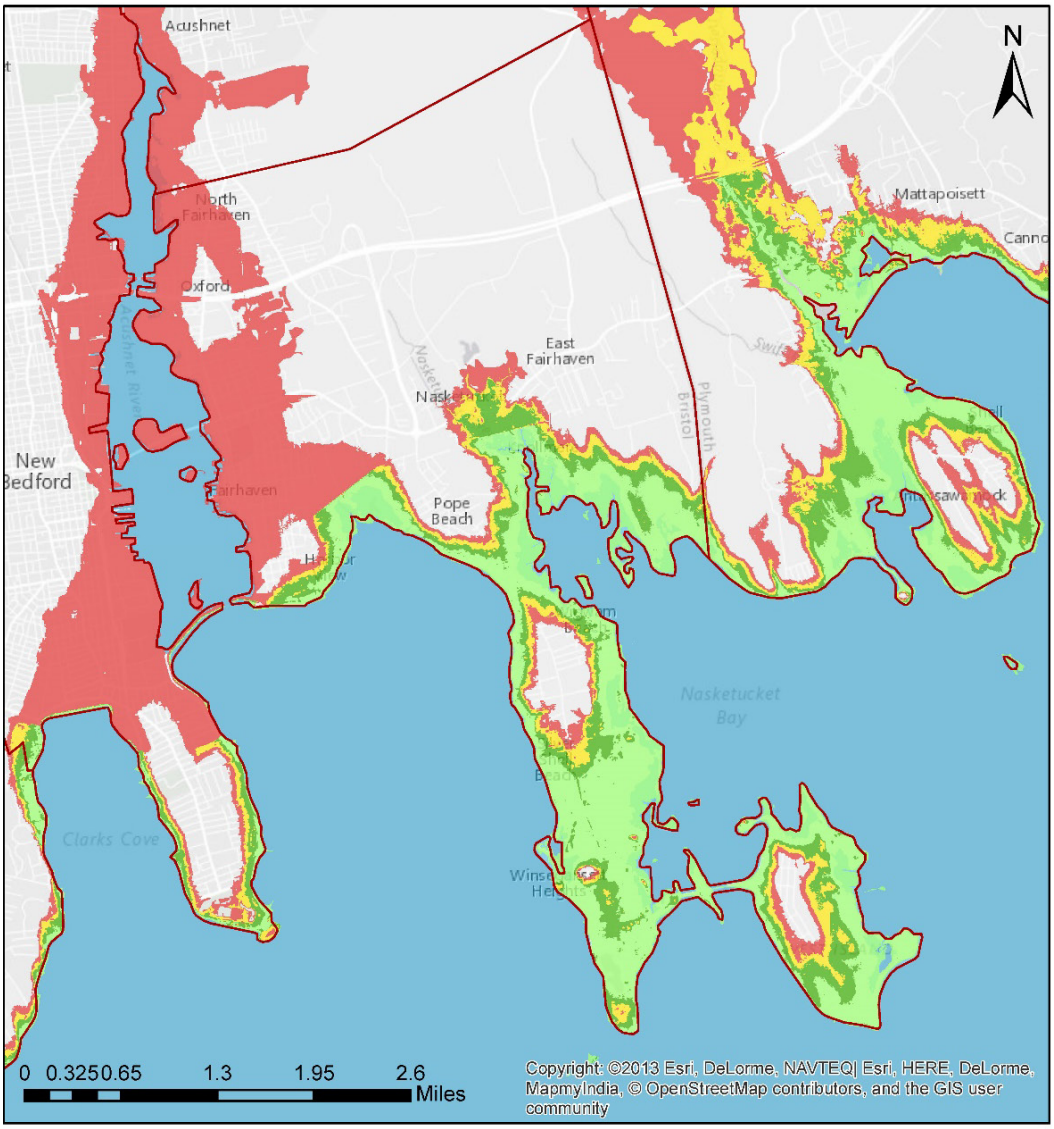


Legend

- Study Baseline Floodplain
- In Floodplain with 1 ft SLR
- In Floodplain with 2 ft SLR
- In Floodplain with 4 ft SLR
- Town Boundary

Source: CZM, Buzzards Bay National Estuary Program

Figure A-12: Hurricane Storm Surge Inundation Areas



Legend

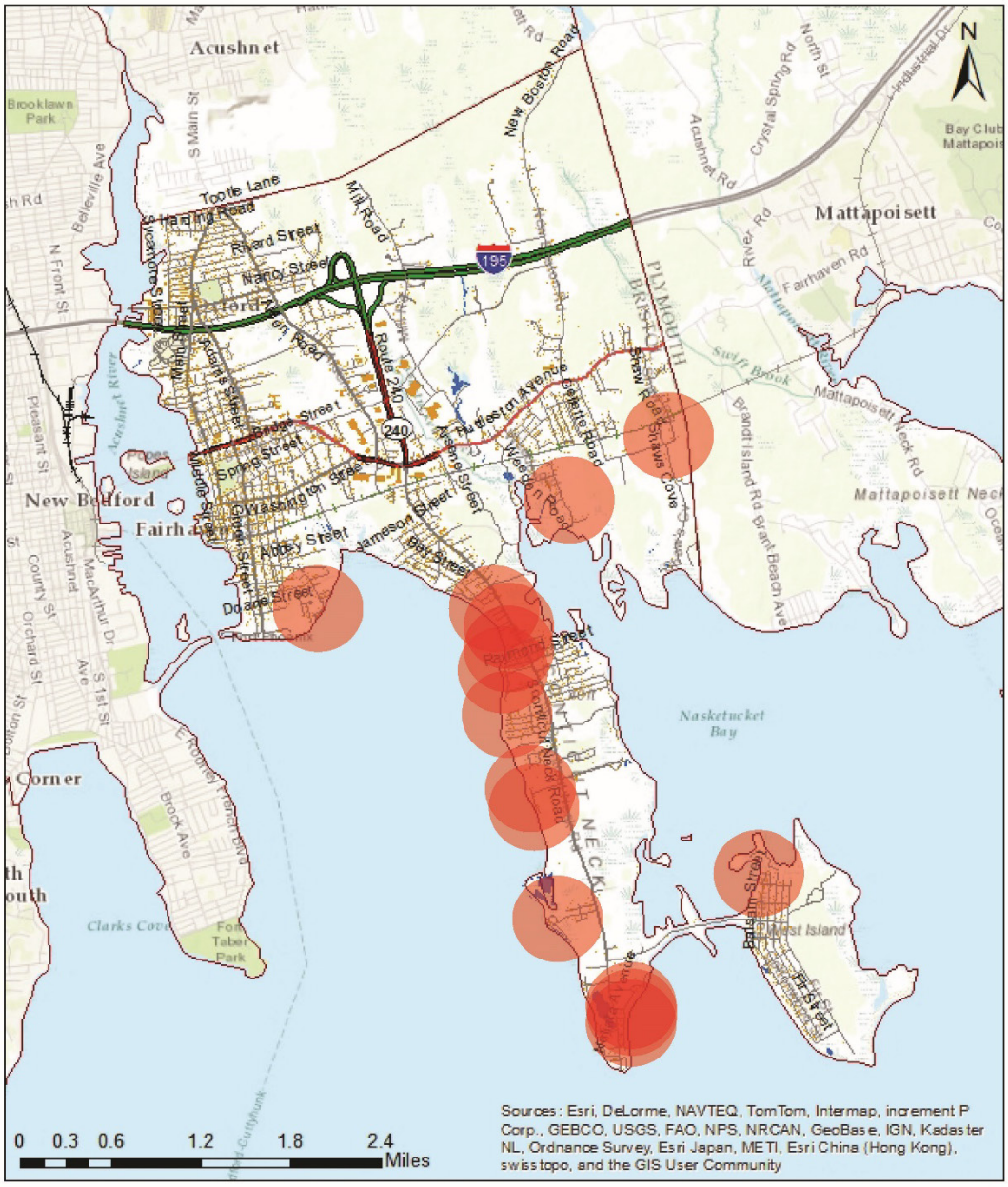
Worst-case Hurricane Surge Inundation Zones

Hurricane Category

- Category 1
- Category 2
- Category 3
- Category 4
- Town Boundary

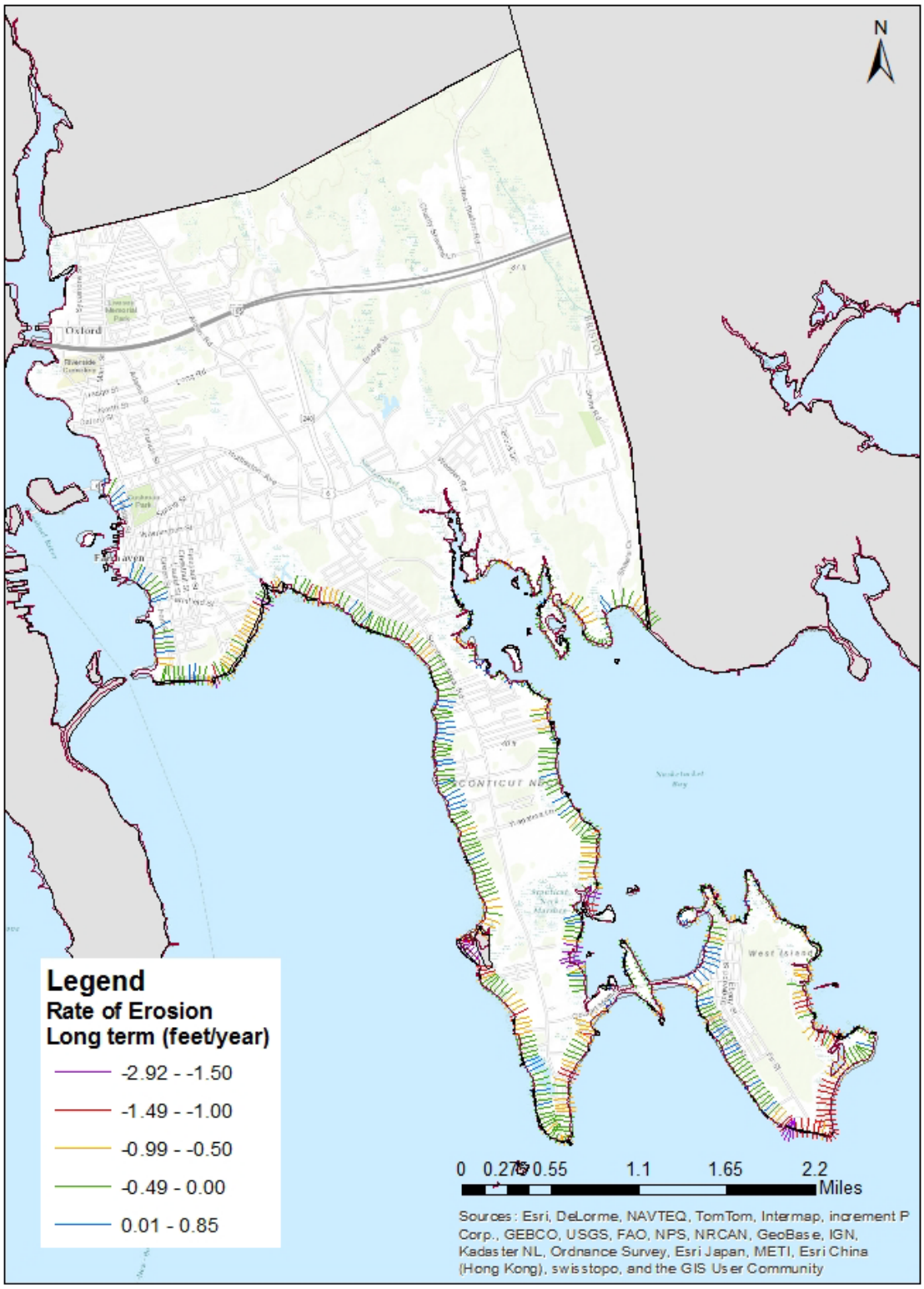
Source: U.S. Army Corps of Engineers, New England District

Figure A-13: Repetitive Loss Areas in Fairhaven



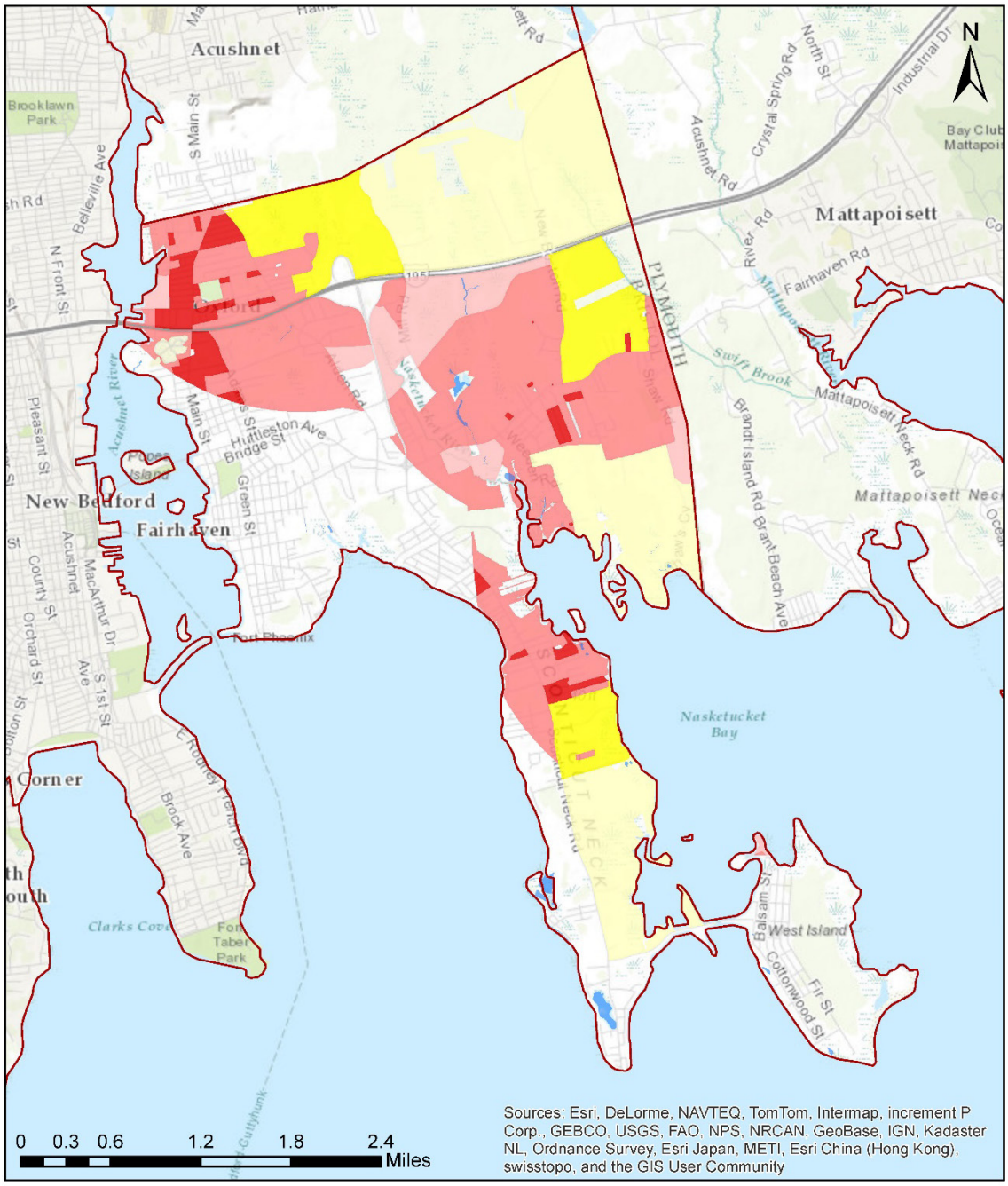
Source: FEMA

Figure A-1: Long-Term Shoreline Change (1845-2009)



Source: Massachusetts Office of Coastal Zone Management

Figure A-10: Wildfire Hazard Areas



Legend

- Town Boundary
- Rivers and Lakes

Wildland Urban Interface

- High Density Interface
- Medium Density Interface
- Low Density Interface
- High Density Intermix
- Medium Density Intermix
- Low Density Intermix

Source: SILVIS Lab, University of Wisconsin-Madison